DOCUMENT RESUME

ED 331 980 CE 057 890

TITLE	Plumbing and Heating Curriculum.
INSTITUTION	EASTCONN Regional Educational Services Center, North Windham, CT.
SPONS AGENCY	Connecticut State Dept. of Education, Middletown. Div. of Vocational, Technical and Adult Education.
PUB DATE	89
NOTE	142p.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	*Air Conditioning; Air Conditioning Equipment; Appliance Repair; *Apprenticeships; Course Descriptions; *Heating; High Schools; Occupational Safety and Health; *Plumbing; Refrigeration Mechanics; Solar Energy; State Curriculum Guides

ABSTRACT

Theory and experience in the following areas are included in this plumbing curriculum: (1) plumbing fixtures and heating; (2) city water service; (3) fixture roughing; (4) venting; and (5) solar heating systems. The plumbing program manual includes the following sections: (1) general objectives for grades 10, 11, and 12; (2) a list of 33 major curriculum areas; (3) competencies for each area; (4) curriculum outline for each area; and (5) student progress record forms. The apprentice-related curriculum manuals in the second part of this document are intended to meet the requirements for achieving journeyworker status and a company's apprentice training requirements. Sixteen apprentice program classes are outlined in the plumbing manual and 20 classes are outlined in the heating/cooling manual. Each course outline includes: (1) length in hours; (2) description; (3) competencies; (4) material covered; (5) textbooks needed; and (6) resources needed. (NLA)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED331980

PLUMBING AND HEATING

CURRICULUM

PREPARED BY EASTCONN
ROUTE 6 (HAMPTON)
NORTH WINDHAM, CT 06256

PREPARED FOR:

CONNECTICUT STATE DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL, TECHNICAL AND ADULT EDUCATION
VOCATIONAL-TECHNICAL SCHOOL SYSTEM
MIDDLETOWN, CONNECTICUT

PROJECT DIRECTOR
DONALD THOMPSON

PROJECT STAFF
JOHN FARRELL, CHAIRPERSON
ALAN GODBURN
GABRIEL MALAFRONTE

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

✓ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

V Dunn

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

THIS PROJECT WAS SUPPORTED BY FUNDS MADE AVAILABLE TO CONNECTICUT THROUGH P.L. 98-524

ALL OPINIONS EXPRESSED REFLECT THE VIEWS OF THE AUTHORS AND ARE NOT NECESSARILY THOSE OF THE CONNECTICUT STATE DEPARTMENT OF EDUCATION

1989

CE057890

BEST COPY AVAILABLE

PLUMBING

Plumbers install, maintain, and repair all types of pipe systems. Although plumbing is sometimes considered a single trade, workers generally specialize in one craft. Plumbers must be able to follow building plans and instructions from supervisor, lay out the job, and work efficiently with the materials and tools of the trade.

Theory and experience in the following areas is included: plumbing fixtures and equipment, city water service, fixture roughing, venting, and solar heating systems.

TABLE OF CONTENTS

General Objectives 1

Curriculum Outline by Major Area 4

Competencies 5

Curriculum Detail 11

Student Progress Record 35

Bibliography 59

GENERAL OBJECTIVES

GRADE 10

At the end of the tenth grade each student will be able to:

1. Use a ruler to make and transfer measurements accurately to plus or minus 1/16 inch.
2. Caulk with lead.
3. Use soldering equipment and perform basic soldering.
4. Cut and thread steel pipe.
5. Operate basic types of power equipment.
6. Meet code and safety standards where required within the scope of the work being performed.
7. Set plumbing fixtures in shop.
8. Make flare fittings.
9. Make up compression fittings.
10. Rough in domestic plumbing in shop.
11. Install one pipe - hot water
    two pipe - hot water
    loop system - hot water
    heat in shop

GRADE 11

At the end of the eleventh grade each student will be able to:

1. Cut and thread 2 1/2 inch through 4 inches steel pipe by hand and with power equipment.
2. Make flanged connections.
3. Caulk horizontal and vertical joints.
4. Rough in domestic plumbing systems.
5. Install flare fittings.
6. Install compression fittings.
7. Make lead pan for shower.
8. Set plumbing fixtures.
9. Install hot water systems - domestic.
10. Do general repair work on domestic plumbing and heating systems.
11. Pipe hot water heaters.
12. Calculate heat losses.

GRADE 12

At the end of the twelfth grade each student will be able to:

1. Work safely with all materials used within the trade.
2. Install plumbing systems - domestic.
3. Install hot water heating systems - domestic.
4. Install solar domestic hot water systems.
5. Do general repair work on domestic plumbing and heating systems.
6. Design plumbing systems.
7. Design hot water heating systems.
8. Pipe one pipe steam system.
9. Pipe two pipe steam systems.
10. Function as an advanced apprentice as defined in the trade.

CURRICULUM OUTLINE BY MAJOR AREA

Unit

I. Orientation
II. Basic Piping Information
III. Cast Iron Work
IV. Copper Tubing
V. Vent Types
VI. Roughing In Waste and Vent Stacks
VII. Plumbing Fixtures and Equipment - Wall Hung
VIII. Traps
IX. Use of Electric Power Tools and Equipment
X. OSHA Requirements
XI. Lead Work
XII. Setting Fixtures and Equipment - Domestic
XIII. Screw Pipe Work and Equipment
XIV. Plastic Pipe Work and Rural Sanitation and Plumbing
XV. Plastic Pipe Sanitation and Plumbing
XVI. Sump Pumps and Rural Water Service
XVII. City Water Service
XVIII. Fixture Roughing
XIX. Cast Iron Pipework
XX. Venting - Advanced
XXI. Cast Iron Repair
XXII. Glass Pipe and Fittings - Introduction Only
XXIII. Copper Tubing Sizing
XXIV. Plumbing Fixtures and Equipment
XXV. Hot Water Heaters
XXVI. Hot Water Heating I
XXVII. Hot Water Heating II
XXVIII. Installation of Domestic Hot Water
XXIX. Hot Water Heating III
XXX. Installation of Solar Domestic Hot Water
XXXI. Welding Pipe
XXXII. Plumbing and Heating Estimating
XXXIII. Customer Relations and Business Practices

COMPETENCIES

I. Shop Orientation

- A. Store Tools and Equipment
- B. Clean Shop and Lockers
- C. Check Machine Guards and Safety Equipment
- D. Shop Rules

II. Basic Screw Pipe Work

- A. Read 6 Foot Ruler
- B. Measure Pipe Diameter
- C. Measure Pipe Length
- D. Size Pipe Fitting
- E. Set Up Bench Vise
- F. Set Basic Type Dies
- G. Cut/Ream Pipe
- H. Thread Pipe
- I. Measure C/C, E/C, E/E
- J. Make Nipple Chuck
- K. Make Pipe and Fitting
- L. Make Offsets/Fitting
- M. Make Nipples
- N. Make Plastic Fittings

III. Cast Iron Pipe Work

- A. Cut Opening in Pipe
- B. Tap an Plug Opening in Pipe
- C. Test Fitting and Pipe for Cracks
- D. Cut/Hammer and Chisel
- E. Snap/Cut
- F. Roll Oakum
- G. Make Yarning Joints
- H. Align Pipe and Fitting
- I. Prepare Lead for Pouring
- J. Pour Vertical Lines
- K. Pour Wet Joints/Oakum
- L. Melt Out Joints
- M. Caulk Edges of Vertical Joints
- N. Caulk Edges of Horizontal Joints
- O. Trim Caulked Joints
- P. Make Offsets/Different Angles
- Q. Install Back Water Valve
- R. Test Roughing (Water, Air)
- S. Cut Pipe Out of Hub
- T. Install Frenco Connector
- U. Install No Hub-Victalic

9

IV. Sweat Copper Tubing/Fittings

A. Different Types/Solder
B. Identify Stock
C. Make Allowance for Bends
D. Cut/Cutter or Hacksaw
E. Ream and Chamfer Ends
F. Bend Tubing
G. Size for Sweating
H. Clean for Sweating
I. Select and Apply Flux
J. Align
K. Sweat/Torch and Electric Heating
L. Sweat Copper Stacks
M. Make Flared Joints
N. Make Compression Fitting

V. Water Heater, Install and Repair

A. Electric Water Heaters
B. Gas Water Heaters
C. Oil Water Heaters
D. Make Vertical Boiler Connections
E. Make Horizontal Boiler Connections
F. Install Tankless Heater
G. Install Relief Valves
H. Install and Operate Safety Devices
I. Install Automatic Controls
J. Install Mixing Valves

VI. Set Lavatories and Equipment

A. Check Roughing Measure
B. Uncrate Fixtures
C. Install Hangers/Wall Fixture
D. Install Lavatory and Trim

VII. Water Heating, Basic

A. Locate Boiler and Burner
B. Build Boiler Foundation
C. Set and Level Boiler Base
D. Compute Buildings Heating Load
E. Compute Sizes of Boilers
F. Size Pipe, Mains, Returns, Risers
G. Compute Radiation Needed

VIII. Power Tools and Equipment

A. Operate 1/2" Electric Drill
B. Operate Pipe Threading Machine
C. Operate Electric Hammer
D. Operate Electric Saws-all
E. Operate Electric Skill Saw
F. Operate Bench Grinder
G. Operate Drill Press
H. Operate 1/4" Electric Drill
I. Operate Sewer Snake

IX. Domestic Fixtures and Equipment

A. Install Kitchen Sink and Trim
B. Install Wash Trays
C. Install Vacuum Breaker
D. Install Bathtub and Trim
E. Install Water Closet and Trim
F. Install Shower Bath and Trim
G. Install Drinking Fountain and Trim
H. Install Urinals and Trim
I. Install Flushometers
J. Install Miscellaneous Fixtures

X. Water Heating - Advanced

A. Cover Pipe and Fittings
B. Install Temperature Regulator
C. Service Equipment
D. Install Boiler Jacket
E. Install Combustion Jacket
F. Install Combustion Chamber
G. Install Zoned Systems
H. Install Flow Control Valve
I. Fill and Drain Expansion Tank
J. Install Boiler and Tank Drain
K. Install Automatic Boiler Feed and Cut-Off
L. Install Air Scoops
M. Install Equalizer
N. Install Expansion Tank, Drain Fittings
O. Install Extrol-Tank
P. Fire Boiler and Test System

XI. Glass Pipe and Fittings

A. Select Required Tools
B. Cut
C. Bead
D. Install Connectors
E. Hang Glass Pipe
F. Test Glass Pipe
G. Bury Underground
H. Back Fill Trenches

XII. Cast Iron Repair Work

A. Determine Special Supports
B. Cut Out
C. Install Sission Fittings
D. Install Three Pieces of Pipe
E. Install "Dutchman"
F. Install Kaffer Tee
G. Install Frenco Connectors

XIII. Install Burners and Controls

A. Burner/Tank, Fire Control
B. Connect Oil Lines
C. Valves Filters, Fill and Vent Pipe
D. All Burner Controls
E. Draft Regulator
F. Pressure Relief Valves
G. Test for Combustion Efficiency

XV. Oxygen-Acetylene Welding

A. Check Equipment and Safety Features
B. Check Cylinders
C. Assemble Hoses
D. Select Tip
E. Set Regulator
F. Light Torch Safely
G. Adjust Flame
H. Weld Tent Position, No Rod
I. Weld Flat Position
J. Weld Butt Joint
K. Weld Lap Joint
L. Weld T-Joint
M. Braze Flat/Bronze Rod
N. Braze Pipe - Vertical Position
O. Braze Pipe - Horizontal Position
P. Shut Off Torch
Q. Store Equipment
R. Assemble Cutting Torch
S. Cut Flat Stock
T. Cut Bar Stock
U. Cut Pipe Stock

XV. Electric Arc Welding

A. Operate Machine Safely
B. Identify Rod Classification
C. Start Machine
D. Maintain Machine
E. Set Amperage
F. Strike an Arc
G. Weld Flat Beads
H. Weld/Weaving Motion
I. Weld Butt Joints
J. Weld Fillet Joints
K. Weld Corner Joints
L. Weld - Horizontal
M. Weld - Vertical
N. Weld - Overhead
O. Identify Metals
P. Read Welding Systems

XVI. Test Equipment

A. Test OHM Meter
B. Test Voltmeter/Ammeter
C. Test Voltage
D. Test V.O.M.
E. Test Wattmeter

XVII. Troubleshooting/Meters

A. Check Feeders
B. Check Fuses, Record Results
C. Check Opens
D. Check Shorts
E. Check Grounds
F. Check Relays, Switches, Controls
G. Check Motors, Transformers, Coils

XVIII. Solar Heating and Hot Water Servicing

A. Install Solar System
B. Install Roof Mount and Panels
C. Set Up Pumps, Gauges, Valves, Controls
D. Insulate Piping
E. Fill and Test System

XIX. Servicing

A. Locate Stoppage, Relieve Drain
B. Freeze Pipes, Make Repairs
C. Thaw Frozen Pipes
D. Locate Leaks in Lines
E. Install Backing for Fixtures
F. Cut Floor Timbers
G. Level Floor Pockets
H. Bore Holes in Wood
I. Drill Steel and Cast Iron
J. Drill Concrete and Brick

XX. Servicing

A. Cut Floor and Walls for Pipe
B. Repair Faucet and Valve
C. Cut Gauge Glass
D. Tend Tool Crib
E. Store Materials
F. Level Built-In Bath Handles
G. Test for Gas Leaks
H. Caulk Leaks

CURRICULUM

I. ORIENTATION

A. What is the Plumbing and Piping Industry and Principles?
B. History - Development of the Industry
C. Fire and Emergency Alarms
D. Means of Egress
E. Emergency Evacuation Procedures
F. Recall
G. Location and Use of Fire Alarms
H. Location and Use of Fire Extinguishers
I. First Aid Procedures
    1. Report all injuries regardless how minor to yourself or classmates
J. Shop Safety Rules
    1. Running
    2. Horseplay, throwing - anything
    3. Crowding
    4. Lifting
    5. Eyes
    6. Clothing
    7. Hair
    8. Open flames
    9. O.S.H.A. (Introduction only)
K. Hazardous Materials
    1. Flammable and combustible
    2. Toxic
L. Machinery
    1. General safety
    2. Machine guards
M. Electrical Safety
    1. Disconnect locations
    2. Hazards
    3. Mandatory precautions

II. BASIC PIPING INFORMATION

A. Read 6 Ft. Rule
B. Pipe Sizes
C. Pipe Fittings
    1. Galvanized malleable
    2. Drainage
    3. Black cast iron
    4. Brass
    5. Plastic
D. Setting Dies for Various Sizes of Pipe Threaders
E. Cutting Oil
F. Pipe Compound
    1. Teflon liquid and tape
    2. Other varieties

G. Cutting, Reaming and Threading to Size
    1. Steel pipe
    2. Brass pipe
    3. Plastic pipe
H. Making a "Nipple Chuck" or Work Holder

III. CAST IRON WORK

A. Safety Precautions and Use of Tools - OSHA
B. Pipe Sizes
C. Pipe Fittings and Sizes
D. Testing Pipes and Fittings for Defects and Cracks
E. Cutting Cast Iron Pipe
    1. Hammer and cold chisel
    2. Wheel soil pipe cutter, snap cutter
F. Caulking - Vertical
    1. Outside
    2. Inside
G. Horizontal Joints
    1. Joint runners
    2. Inside
    3. Outside
    4. Cutting excess lead
H. Making Offset Angle Bends
    1. Use of steel square
    2. Six (6) foot plumber's rule
    3. Computing angles with trigonometry formulas
I. Installing Back Water Valves or Tide Traps
    1. Balanced
    2. Unbalanced
J. Roughing In
    1. House drain
    2. House sewer
K. Testing Rough Plumbing
    1. With air
    2. With water
L. No Hub
M. Rubber Joints
N. Victalic
O. Lead and Oakum
P. Frenco Connectors

IV. COPPER TUBING

A. Identifying Stock
    1. Sizes of tubing
        a. hard and soft
        b. straight lengths - coils
    2. Fittings
        a. sweat - cast - wrought
        b. flared
        c. compression

3. Copper tubing
    a. "L" type
    b. "M" type
    c. "K" type
    d. D.W.V. type
    e. ACR type

B. Measuring, Cutting, and Reaming Tubing

C. Cleaning
    1. Tubing ends
    2. Inside of fitting hub

D. Applying Fluxes: Types
    1. No Korode
    2. Surflux
    3. Laco
    4. Borax (Silver Solder)
    5. Swif Solder

E. Types of Installation
    1. Flare
    2. Sweat
    3. Compression

F. Aligning
    1. Pipe
    2. Fitting

G. Use of Solder for Sweating
    1. Solder
        a. 50/50
        b. 95/5
        c. 70/30
        d. 40/60
    2. Hard Solder
        a. silver solder

H. Sweating Joints
    1. With Prest-O-Lite equipment
    2. Insto-Gas tank
    3. Electric sweating equipment

I. Bending Copper Tubing - Annealing Copper Tubing - Making Allowances for Bends

J. Installation of Copper Stacks
    1. Waste lines
    2. Vent
    3. Soil

V. VENT TYPES

A. Various Types of Vents, Where, How and Why they are used
    1. Back-vent
    2. Branch-vent
    3. Circuit vent
    4. Common or Individual vent
    5. Continuous vent
    6. Sump vent
    7. Yoke vent

8. Loop vent
9. Main vent - stack
10. Relief vent
11. Side vent
12. Stack vent
13. Waste and vent combination
14. Wet vent

VI. ROUGHING IN WASTE AND VENT STACKS

A. Code
B. Types of Materials
   1. Galvanized pipe
   2. Cast iron
   3. Plastic
   4. Copper
   5. Glass

VII. PLUMBING FIXTURES AND EQUIPMENT - WALL HUNG

A. Installing Hangers for Wall Hung Fixtures in
   1. Plastered walls
   2. Tiled walls
   3. Brick walls
   4. Cinder block walls
   5. Concrete walls
   6. Sheet rock
B. Installing a Lavatory and Trim
C. Installing Water Supplies and Waste Lines to Fixtures, from Manufacturers'Roughing in Measuring Shell

VIII. TRAPS

A. Installation of Traps
   1. Building traps
      a. running traps
   2. 1/2 S or P-Traps
   3. Grease separator
   4. Oil separator
   5. Drum trap

IX. USE OF ELECTRIC POWER TOOLS AND EQUIPMENT

A. Drill - Standard and Angle - 1/2"
B. Power Pipe Threading Machines
C. Electric Hammer
D. Reciprocal Saw

E. Circular Saw
F. Bench Grinder
G. Bench Drill Press
H. Hand Drill - 1/4", 3/8"
I. Bits
    1. Wood
    2. Steel
    3. Concrete and masonry bits
J. Sewer Snake

X. OSHA REQUIREMENTS

A. Glasses
B. Hard Hats
C. Staging
D. Ladders
E. Electrical Grounding and Circuit Interrupters
F. General Construction Safety
G. Trenches - Ditches

XI. LEAD WORK

A. Measuring and Cutting Sheet Lead for Shower Pan
    1. 4 lb.
    2. 8 lb.
B. Forming Lead Pan
    1. Corners
    2. Cutting holes for drain
C. Soldering Lead Pan
    1. Seams
    2. Drains
D. Installing Lead Pan

XII. SETTING FIXTURES AND EQUIPMENT - DOMESTIC

A. Installation Procedure
    1. Check roughing measurement
    2. Install hangers for wall hung fixtures
    3. Install kitchen sink and trimming
    4. Install wash trays
    5. Test
    6. Install bathtub and trimming
    7. Install lavatory and trimming
    8. Install water closet and trimming
    9. Install shower, bath and trimming
    10. Test
    11. Install drinking fountain and trim
    12. Install urinals and trimming
    13. Install flushometers
    14. Install miscellaneous fixtures
    15. Protecting fixtures after installing
    16. Garbage disposal
    17. Automatic washing machines and dishwashers
    18. Test
    19. Fiberglass fixtures

XIII. SCREW PIPE WORK AND EQUIPMENT

A. Installation of Swing Joints and Expansion Joints
B. Pipe Bending
    1. Hydraulic bender
    2. Templates
    3. Floor templates
    4. Making allowances for bends
C. Safety Precautions - OSHA
D. Cutting and Threading Sizes 2 1/2" to 4" Pipe
    1. Ratchet handle
    2. Universal drive
    3. 2-Wheel drive
    4. Power drive
E. Making Flange Connections
F. Installing Pipe Railings
G. Use of Tank Nipples (long threads)

XIV. PLASTIC PIPE WORK AND RURAL SANITATION AND PLUMBING

A. Theory of Septic Tanks
    1. Metal
    2. Cement
B. Connecting to Septic Tanks (1000 Gal.)
    1. Capacity of tanks - metal or cement
    2. Locations of septic tanks
    3. Elevation of septic tanks
C. Installation of Septic Tank Fields
    1. Dry well
    2. Leaching pit
    3. Leaching fields
    4. Leaching gallons
    5. Distribution field
D. Sewage Disposal Requirements

XV. PLASTIC PIPE, SANITATION AND PLUMBING

A. Establishing Grade for Sewer Lines
    1. Compute necessary grade
    2. Establish depth of main sewer line
    3. Locate main sewer line
    4. Proper use of surveyor's transite
    5. "Bench Marks"

XVI. SUMP PUMPS AND RURAL WATER SERVICE

A. Installation of Water Sump Pumps
   1. Types of sump pumps
      a. electric
      b. water siphon
      c. submerged
   2. Proper size of pit
   3. Surface water discharged
   4. Sizes of inlet and outlet connections
   5. Proper size discharge line

B. Installation of Well Pumps
   1. Depth and type of well
      a. shallow well
      b. deep well
      c. artesian well
         1. dug
         2. bored
         3. driven
         4. tubular
         5. drilled
   2. Number and elevation of fixtures to be served
   3. Types of well pumps
      a. single action
      b. double action
      c. duplex piston pump
      d. centrifugal pump
      e. submersible pump
   4. Types of storage equipment used
   5. Installation of automatic controls

C. Installation of Water Treatment Devices
   1. Analyze water for
      a. hardness
      b. softness
      c. mineral content
      d. contaminants
   2. Affect of the water on
      a. brass pipe
      b. galvanized steel pipe
      c. galvanized wrought iron pipe
      d. copper tubing
      e. plastic
   3. Use of water filters
      a. horizontal pressure filters
      b. vertical pressure filters
   4. Use of water softeners
      a. manually reactivated water softener
      b. semiautomatic water softener
      c. automatic water softener

D. State and Local Requirements

XVII. CITY WATER SERVICE

A. Connecting Water Service to Street Main
   1. Check specifications for size of water main
   2. Proper location of curb-box
   3. Location of water meter
   4. Brass swing joint
   5. Type of material to be used for water main
      a. copper tubing
      b. plastic
      c. bell and spigot cast iron pipe
   6. Local water company requirements

XVIII. FIXTURE ROUGHING

A. OSHA Requirements
B. Installing Supplies and Waste from Roughing-in Sheets to Plumbing Fixtures
   1. Determine Location and Height of fixtures
   2. Measure length, width, and height of fixtures
   3. Cutting and installing trap "Waste Line"
   4. Measuring, cutting, and installing water lines to fixtures
   5. Testing fixture and piping connections for leaks
C. Installing Waste Lines
   1. Interpret BOCA plumbing code requirements
   2. Kind of materials a waste line may be constructed of
   3. Proper grading, aligning, and sizing of waste pipe
   4. Classification of waste pipe
      a. direct
      b. indirect

XIX. CAST IRON PIPE WORK

A. Safety Precautions and Proper Use of Tools - OSHA
B. Making Offset with Angled Bends
   1. Use of steel square
   2. 6 foot plumbers rule
   3. Computing angles
C. Installing Back Water Valve/Tide - Trap
   1. Balanced
   2. Unbalanced
   3. Where and why back water valves are installed on sewer lines
D. Roughing-In
   1. House drain
      a. the function and location of house drain
      b. kind of materials used on house drain installation
      c. drain classification
         1. sanitary sewers
         2. storm sewers
         3. industrial sewers
      d. where and why it is necessary to install cleanouts on house drains
      e. the proper grading of pipe lines and drains

2. House sewers
    a. importance of care in the installation of a house sewer
    b. connection of house sewer to main street sewer
    c. grading of a house sewer
    d. installation of the house sewer in various types of soil

E. Roughing-In
    1. Understanding the BOCA plumbing codes
    2. Permits required to do the job
    3. How to interpret/read Roughing-In Sheets
    4. Visualize complete job elevation-floor plans (blueprints and specifications)
    5. Proper spacing of bathroom fixtures

XX. VENTING - ADVANCED

A. Types of Vents, Where, Why and How They Are Used
    1. Back vent
    2. Branch vent
    3. Circuit vent
    4. Common vent or individual vent
    5. Continuous vent
    6. Sump vent
    7. Yoke vent
    8. Loop vent
    9. Main vent - stack
    10. Relief vent
    11. Side vent
    12. Stack vent
    13. Waste and vent combination
    14. Wet vent

B. Roughing-In Waste and Vent Stacks with
    1. Cast iron soil pipe
    2. Glass pipe
    3. Plastic pipe
    4. Copper tubing

XXI. CAST IRON REPAIR WORK

A. Cutting-in and Installing New Fittings in Old Soil Lines
    1. In partitions
        a. line must be braced
        b. use of a Sission fitting
        c. use of three pieces of pipe
        d. Frenco connectors
    2. Underground
        a. use of kaffer tee
        b. use of a "Dutchman" as a filler pipe
        c. Frenco connectors

XXII. GLASS PIPE AND FITTINGS - INTRODUCTION ONLY

A. Use of Glass Pipe, Fittings, and Equipment on Plumbing Installations
   1. Safety precautions
   2. Regular schedule pipe and fittings
      a. manufactured in five and ten foot lengths
      b. cutting
      c. beading
         1. plug end of pipe
         2. heating glass pipe
         3. rolling glass pipe
         4. use of a bend gauge
      d. assembling (use a special coupling
      e. hanging
      f. horizontal runs
      g. vertical runs
      h. testing

B. Continuous Venting
   1. Use of P or 1/2 "S" trap
   2. Type of fittings used in continuous venting
   3. How fittings are used in this type of venting
   4. Why this type of vent is superior

C. Loop and Circuit Venting
   1. Plumbing code requirements
   2. Clear definition of loop and circuit venting
   3. Cost differential between loop, circuit and common type venting systems
   4. Position of "Y" in loop and circuit venting

D. Local Venting
   1. Where, how, and why local venting is required in a plumbing system
   2. Materials used on a local vent installation
   3. Terminus point of local vent systems

E. Special Applications
   1. Of what kind of material they are constructed
      a. cast iron
      b. glass
      c. plastic
      d. copper
   2. Where and how used
      a. science room
      b. hospitals
      c. public toilet rooms
      d. chemical laboratories
      e. soil stack, waste lines, and vent lines
   3. Heavy schedule
      a. burial underground
      b. underneath concrete
      c. coating glass pipe and fittings with mastic cement
      d. back fill with rock-free sand or concrete
      e. testing

XXIII. COPPER TUBING SIZING

A. Sweating Joints
   1. Safety precautions
   2. Various types of burner tips used on large sized tubing sweat joints
   3. Use of Prest-o-Lite torch
   4. Use of Insto-Gas tank and burner tip
   5. Regulate gauge and adjust flame on an acetylene unit

B. Copper Stacks
   1. Sizing copper stacks
      a. use of fixture unit formula
      b. proper size vent to be used
      c. number of fixtures allowed to discharge into a given size main soil line
   2. Installation of Copper Tubing Stacks, Vents, and Waste Lines
      a. type of tubing to be used
      b. DVW and type "M" tubing
      c. Where, when, and how to install drainage copper tubing fittings
      d. type of sweat solder to be used
      e. different kinds of fluxes used on copper tubing sweat joints
         1. Nokorode flux
         2. Laco flux
         3. Swif-solder flux
      f. BOCA plumbing code requirements for installation of copper tubing on systems

XXIV. PLUMBING FIXTURES AND EQUIPMENT

A. Installing Hangers for Wall-Hung Fixtures on
   1. Plastered walls
   2. Tiled walls
   3. Brick walls
   4. Cinder block walls
   5. Concrete walls
   6. Sheet rock

B. Installing Kitchen Sink and Trim
   1. How to read rough-in sheets
   2. Common types of makes of kitchen sinks
   3. Proper location, height, and center spacing of fixture
   4. Roughing-out
      a. water lines
      b. waste lines - vent lines
   5. Use of "P" traps
   6. Common types of faucets used on kitchen sink installation
      a. combination faucet
         1. with spray hose
         2. without spray hose
         3. with soap dish
         4. without soap dish
         5. without hose and soap dish

C. Installing Wash-Trays (Laundry Tubs)
   1. Check roughing measurements
   2. Common types of wash trays and trim
   3. How waste is removed from fixture when waste line is installed below house drain level
   4. Use of pumps or ejectors for removing waste materials from wash trays

D. Installing Vacuum Breakers
   1. Types and sizes of vacuum breakers
   2. Where and why vacuum breakers are used
   3. Types that are prohibited and why
   4. Construction and operation of vacuum breaker

E. Installing Bath Tub and Trim
   1. Check rough-in measurements
   2. BOCA plumbing code requirements
   3. Location of water supplies and waste line
   4. Types of fixtures, right or left-hand waste outlet
   5. Installation of a swivel bath trap
   6. Use of a diverter bath fixture
   7. Operation of a trip lever waste fixture
   8. Install a piece of 2" x 4" timber to support
   9. Protect fixture and trim after it has been tested
   10. Fiberglass unit

F. Installing Lavatory and Trim
   1. Refer to roughing-in sheets
   2. Proper height of fixture
   3. Locating fixture hanger (brackets)
   4. Roughing-in waste lines
   5. Roughing-in hot and cold water supplies
   6. Use of flexible supply connections
   7. Installing A.C.P. covering tube
   8. Installing C.P. "P" trap
   9. Testing fixtures and piping for leaks

G. Installing Water Closet and Trim
   1. Check rough-in measurement
   2. Set floor flange
   3. Place closet bolts in floor flange
   4. Mount closet tank
   5. Connect flexible supply to fixture
   6. Test fixture for leaks
   7. Adjust height of water in tank

H. Installing Shower Bath and Trim
   1. Types of shower baths
      a. receptor
      b. shower in bathtub
      c. shower cabinet
      d. shower stall
      e. fiberglass unit
   2. Installation of mixing valve
   3. BOCA plumbing code requirements for proper size waste and vent lines

I. Installation of Drinking Fountain and Trim
    1. Check rough-in sheets
    2. BOCA plumbing code requirements
    3. Determine proper size trap for waste line
    4. Methods of removing waste materials
        a. direct waste connection to plumbing system
        b. indirect waste connection to plumbing fixture

J. Installation of Urinals and Trim
    1. Type or urinals in use
    2. BOCA code requirements for waste and lines
    3. Why base of urinal is set in sand
    4. Flushing fixtures
        a. self-flushing tanks
        b. Flush-O-Meter valves
        c. flow control valves
    5. Use of and connection to local vents
    6. Installation of an air chamber on water supply lines to fixture

K. Installing Flush-O-Meter Valve
    1. Construction and operation of Flsuh-O-Meter yalve
    2. Installation of a Flush-O-Meter valve
    3. Necessary water pressure required to properly operate valve
    4. Where and why an air chamber is installed on the water supply line

L. Installing Automatic Washing Machine
    1. BOCA code requirements for waste-vent lines
    2. Check roughing-in measurements
        a. hot and cold water supplies
        b. discharge pipe connection
            1. direct connection
            2. discharge into an open stand-pipe
            3. is a separate dry well required to receive discharge waste material

M. Installing Dish Washing Machine
    1. BOCA plumbing code requirements
        a. size of waste line
        b. size of vent line
    2. Check manufacturer's roughing-in measurements
    3. Location of hot water line
    4. Location of fixture trap

N. Installing Dental Chairs
    1. Refer to BOCA code requirements
    2. Check manufacturer's roughing-in sheet and locate
        a. waste line
        b. vent line
        c. water supply
        d. air line
    3. type of waste connection used
        a. direct waste connection
        b. indirect waste connection
    4. Use of running trap

O. Installing Garbage Disposal
    1. Check manufacturer's roughing-in measurements
    2. Common types and makes of disposal units
        a. high roughing-in type
        b. low roughing-in type
    3. Size waste line and trap
    4. Installation of an electric switch on cold water line
P. Handicapped Fixture Roughing-in and Installation

XXV. HOT WATER HEATERS

A. Installation of Hot Water Heaters
    1. Indirect
    2. Automatic
        a. gas
        b. electric
        c. oil
    3. Tankless
    4. Direct
B. Installation of Safety Devices
    1. Circulation system
    2. Automatic controls
    3. Mixing valves

XXVI. HOT WATER HEATING - I

A. Calculating and Making Pipe Connections and Offsets
B. Grading Pipe Lines and
    1. Pipe supports
        a. angle brackets
        b. "J" hangers
        c. Clevis hangers
    2. Cement inserts
C. Making Radiator Connections
D. Theory of Flow and Distribution of Water in Hot Water Systems
E. Theory of Heat
    1. B.T.U. heat standards
    2. Radiation
    3. Convection
    4. Conduction
    5. Factors
    6. Losses in various types of systems
F. Computing Building Heat Losses
G. Theory of Pressure Relief Valves
H. Theory of Automatic Water Feeder and Cut-off Controls on Steam and Hot Water Boilers

XXVII. HOT WATER HEATING - II

A. Determining Location
    1. Of the chimney
    2. Furnace base

B. Assembling and Installation
    1. Boiler sections
        a. tubular boilers
        b. section boilers
    2. Installing trim
        a. on hot water heating boilers
C. Location and Assembling Radiators and Cast Iron Baseboard Radiation, an Copper Fin Tube Radiation
D. Making Radiator Connections
E. Installing Temperature Regulators
F. Computing Radiation
G. Theory of Flow and Distribution of Water in Hot Water Systems
H. Theory of Volume of Water Required to Supply Radiators
I. Computer Rating of Hot Water Heating Boilers
J. Theory of Heat
    1. B.T.U. heat standards
    2. Radiation
    3. Convection
    4. Conduction
    5. Factors
    6. Losses in various types of systems
K. Computing Equipment for Zone Control Systems
    1. Expansion tank
    2. Flow control
    3. Circulator
    4. Motorized valves
    5. Thermostats
    6. Relay controls
L. Computing Building Heat Losses
M. Calculating Cast Iron Convection Cabinet Type
N. Theory of Pressure Relief Valve
O. Theory of Automatic Water Feeders and Cut-Off Controls on Boilers

XXVIII. INSTALLATION OF DOMESTIC HOT WATER

A. Theory of Circulating Systems
    1. Tank pressure
    2. Direct pressure
    3. Types of circulating systems
        a. loop
        b. up-feed
        c. down-feed
B. Mixing Valves for Domestic Hot Water
    1. Location
    2. Types and sizes of mixing valves
    3. Installation height on tankless water heaters
    4. Use of water flow-restriction (water flow-regulator)
    5. Use of valve for back flushing tankless water heater coils
    6. Water saving devices
C. Theory, Installation, and Operation of Safety Devices
    1. Pressure and temperature controls
    2. Safety relief valves
    3. Thermostatic control valve for gas water heaters
    4. Thermostatic mixing valves

D. Series Circuit Principles
    1. Connecting and reading a voltmeter
    2. Connecting and reading an ammeter
    3. Connecting and reading an ohmmeter
    4. Voltage in series circuit
    5. Current in series circuit
    6. Resistance in series circuit
E. Parallel Circuit Principles
    1. Voltage parallel circuit
    2. Current parallel circuit
    3. Resistance parallel circuit
F. Ohm's Law I = E/R
    1. Ohm's Law E=IxR
    2. Ohm's Law R=E/I
    3. Ohm's Law applied to part of a circuit
G. Use of Meters
    1. Ohm Meters
        a. in a series circuit
        b. in a parallel circuit
    2. Voltmeter
        a. in a series circuit
        b. in a parallel circuit
    3. Ammeter
        a. in a series circuit
        b. in a parallel circuit
    4. Voltage tester
        a. in a series circuit
        b. in a parallel circuit
H. Circuit Protection
    1. Fuses
    2. Thermal breakers
    3. Magnetic breakers
    4. Oil breakers
    5. Air blast type
I. Burner and Temperature Controls
    1. Burner controls
    2. Stack controls
    3. Temperature controls
J. Theory and Installation of Automatic Controls
    1. Types of controls
        a. strap-on
        b. immersion
        c. well-type
    2. Where controls are installed
        a. on hot water heating systems
        b. oil fired compact units
    3. Proper temperature setting
    4. Controls of domestic hot water on a steam heating boiler
        a. pressuretrol
        b. aquastat
            1. low voltage
            2. line voltage
        c. hot water heating systems
            1. summer-winter controls
            2. reverse acting aquastat

XXIX. HOT WATER HEATING - III

A. Estimating Materials for Hot Water Heating System
   1. Amount of material to be used
   2. Size of job
   3. Type of hot water system to be installed
      a. one pipe
      b. two pipe with direct return
      c. two pipe reverse return
      d. loop

B. Computing Radiation
   1. Type of radiators
      a. cast iron baseboard
      b. free-standing radiators
      c. convection (convectors)
      d. copper fin tube
   2. B.T.U. method
   3. 2, 20, 200 method
   4. I.B.R. guide
   5. Heat loss by exposure
      a. outside walls (exposed walls)
      b. windows
         1. wood
         2. steel sash
      c. high ceilings
      d. door openings
      e. uninsulated ceiling
      f. open attics
      g. concrete floors
   6. Type of building
      a. wood frame
      b. concrete block
      c. brick
      d. stucco
      e. cinder block

C. Computing Sizes of Heating Boilers
   1. Common types of heating systems - hot water
   2. Net I.B.R. rating
   3. Gross I.B.R. output B.T.U. per hour
   4. Domestic hot water
      a. external tankless water heater
      b. internal tankless water heater
   5. Maximum installed radiation
   6. Type of radiation used
      a. cast iron baseboard
      b. vulcan tube
      c. convectors
      d. free standing radiators
      e. fin tube
   7. Provisions for future addition to building
   8. Water capacity in gallons
      a. hot water boilers

9. Rating of oil burner - input gallons per hour
10. Size of heating mains and return lines on hot water systems
11. Heat loss through piping on or through hot water systems
    a. steel pipe
    b. copper tubing

D. Computing Pipe Sizes for Mains and Risers (by formula)
1. Size by valve area method
2. Size by factor method
3. Use of I.B.R. guide
4. Calculations should include
    a. carrying loads
    b. reduction
    c. distance
    d. friction
    e. types of materials used and bends
        1. steel pipe
        2. copper tubing
        3. 45-degree elbows (in offsets)
        4. 90-degree elbows (in offsets)

E. Theory of Heat Transfer: Conduction, Convection, and Radiation
1. BTUs
2. Factors
3. Losses in various types of heating systems hot waters
4. Transfer of heat from one body to another
5. Conveying heated water from one point to another
6. Use of a separate circuit when convectors and cast iron radiators are used on the same heating system
7. Pressure drop on convector unit systems
8. Radiation
    a. average temperature for various BTU emissions
    b. transfer of heat through currents of air

F. Zone Control System
1. Types and sizes of circulators
2. Number of zones to be used
3. Type of radiation
    a. cast iron baseboard
    b. vulcan tubes
    c. convection
    d. free-standing radiators
    e. sun-rad radiation
    f. fin tube
4. Hot water heating systems
5. Types of electrical controls

G. Theory of Pressure Combination Relief Valves
1. Common types of relief valves in use
2. Simple relief valves
    a. brass valve
    b. iron valve
3. Self-filling valve - combines functions of
    a. reducing valve
    b. strainer
    c. by-pass valve

4. Relief and reducing valves factory set for correct working pressure
    a. relief valve opens at 30 lbs.
    b. reducing valve for working pressure of system

H. Automatic Boiler Water Feeder and Cut-offs
1. Types of water feeders
2. Types of automatic cut-offs
3. Various sizes of feeders and cut-offs
4. Theory of the installation and operation of water feeders
5. Function of a cut-off control
6. Safety feature on automatic water feeders
7. Use of by-pass connections
8. Safety feature of an automatic cut-off

XXX. INSTALLATION OF SOLAR DOMESTIC HOT WATER

A. Sizing, Installation and Operation of Systems
1. How to define your climate
2. Solar language
3. Solar geometry
4. Solar altitude and azimuth
5. Collector arientation and tilt system setting collector shading solar window

B. Flat Plate Collectors - Component Description
1. Batten
2. Cover plate
3. Heat transfer
4. Insulation
5. Enclosure

C. Storage (water heaters)

D. Distribution Network
1. Pipes
2. Pumps
3. Valves
4. Heat exchangers
5. Insulation
6. Manual and automatic
7. Expansion tanks
8. Filters

E. Collector Mounting
1. Rack mounting
2. Direct mounting
3. Stand off mounting
4. Integral mounting

F. Heat Exchangers
1. Shell and tube
2. Shell and double tube
3. Dougle wall

F. Rules of Thumb in Evaluating Solar Hot Water Systems
1. Durability
2. Case of repair
3. Susceptibility to either freezing or overheating
4. Protection against corrosion

5. Protection against leaks
6. Consumer protection
7. Insulation
8. Pitch of pipes
9. Bleeding mechanism
10. Fans and pumps
11. Test
12. Controls
13. Standards

H. Closed Loop (sum works solar domestic hot water systems)
I. Oper. Loop Recirculation System
J. Open Loop Automatic Draindown
K. Solar Access
L. System Layout
   1. Draindown system
   2. Drainback system
   3. One-tank closed-loop system
   4. Two-tank closed-loop system
   5. Thermosiphon system
   6. Air system
M. Transfer Fluids, Piping and Ductwork
   1. Corrosion
   2. Water
   3. Clycol/water antifreeze solutions
   4. Water/glycol installation, safety and maintenance
   5. Paraffinic and mineral oils
   6. Aeromatic oils
   7. Water/glycerine solutions
   8. Air
N. Recommended Types of Plumbing
   1. Plastic pipe
   2. Galvanized threaded pipe
   3. Silicone coupling hoses
   4. Copper tubing
   5. Hanging and anchoring pipe
   6. Pipe runs
   7. Expansion
   8. Underground plumbing
   9. Sizing
   10. Installation tips
   11. Reverse return hookups
   12. Series hookups
O. Insulation
   1. Insulation materials and amounts
      a. Fiberglass, elastomers (ArmaflexR, Rubatex, etc.)
      b. Urethane and isocyanurates
   2. Solar DHW Insulation Requirements
      a. pipe under 1-inch diameter R-4
      b. pipe over 1-inch diameter R-6
      c. fiberglass R-3
      d. elastomers R-3.5
      e. urethane R-6.5
      f. isocyanurates R-7+

T. Valves and Gauge Selection
   1. Backflow preventer
   2. Check valve (one-way valve)
   3. Pressure relief valve
   4. Temperature and pressure valve
   5. Tempering and mixing valve
   6. Pressure reducing valve (pressure regulator)
   7. Air vents
   8. Air eliminator (air separator)
   9. Balancing valve
   10. Solenoid valve
   11. Three-way valves
   12. Vacuum relief valve
   13. Insulation valve (shutoff valve)
   14. Fill valve
   15. Boiler drain valve
   16. Pressure gauge
   17. Thermometers
   18. Elapsed time meter
   19. Damper (air system)

U. Expansion Tank
   1. Diaphragm or bladder expansion tank
   2. Sizing expansion tanks
   3. Installation of expansion tank

V. Heat Exchangers and Storage Tanks
   1. Types of heat exchangers
   2. Heat exchanger designs
   3. Sizing heat exchangers
   4. Installing heat exchangers

W. Storage Tanks and Systems
   1. Single tank vs. two tank systems
   2. Types of storage tanks
   3. Inspecting storage tanks
   4. Placing storage tanks
   5. Installing storage tanks

X. System Controls
   1. The sensor subsystem
   2. The differential thermostat
   3. The output subsystem
   4. Preparing for installation
   5. Mounting the control panel
   6. Wiring
   7. Mounting collector sensor
   8. Mounting tank sensor
   9. Mounting frost sensor
   10. Hookup and testing

Y. Safety
   1. Electrical safety
   2. Maintenance personnel safety
   3. Pedestrian and visitor safety
   4. Heat transfer fluid safety

Z. Checkout and Charge-Up
   1. CLosed loop system - hydrostatic test
   2. Draindown system - drain line test
   3. Air system - leak detection
   4. Pumps and sensors
   5. Charging the system
   6. Flushing the system
   7. Filling from the bottom
   8. Filling from the roof or high end of the system
   9. Charging follow-up
   10. Connecting the solar DHW system to the conventional system

AA. Maintenance of System
   1. Collectors
   2. Heat transfer fluids
   3. Pumps and blowers
   4. Pressure gauges
   5. Plumbing
   6. Air vents
   7. Valves
   8. Storage tanks
   9. Specific maintenance for draindown systems

XXXI. WELDING PIPE

A. Oxyacetylene Welding
   1. Personal safety - OSHA
      a. clothing
      b. use of protective equipment
   2. Care and handling of cylinders and equipment
      a. stationary equipment
      b. mobile equipment
      c. gauges and hoses
   3. Welding theory
      a. introduction to welding
      b. the oxyacetylene torch
         1. the venturi-proportioning
         2. the pressure-proportioning
      c. flame adjustment
         1. reducing
         2. neutral
         3. oxidizing
   4. Oxyacetylene welding in
      a. flat position
      b. vertical position
      c. fixed horizontal position
   5. Brazing alloys
   6. Use of jigs and fixtures
   7. Cutting cupons to be tested for tensile and bend strength
   8. Cutting and beveling pipe
      a. square cuts
      b. bevel cuts
      c. selection of proper tips
      d. cutting defects
   9. Test on welded pipe

B. Metallic Arc Welding
    1. Personal safety
        a. face protection
        b. eye protection
        c. clothing
    2. Welding theory
        a. basic electricity
        b. welding machines
    3. Metallic arc welding in
        a. flat position
        b. vertical position
        c. fixed horizontal position
    4. Welding hangers, brackets, and frames from angle iron, round, and square stock
    5. Cutting cupons to be tested for tensile and bend strength
    6. Test

XXXII. PLUMBING AND HEATING ESTIMATING

A. Preparing for the Estimate
    1. Estimating tools
    2. Take-off forms
    3. Estimate forms
    4. Summary sheet
    5. BOCA plumbing codes
    6. Vendor catalogs
    7. Trade price sheets
    8. Working areas
    9. BOCA heating codes
B. The Take-Off
    1. Reading and digesting specifications
    2. Making notes about specifications
    3. Becoming familiar with the drawings
    4. Coordination of both plumbing and heating drawings and specifications
    5. Take-off quantities from drawings
C. Writing and Pricing the Estimate
    1. Writing the estimate
    2. The art of pricing
    3. Material pricing and discounts
    4. Composition of the labor man-hour
D. Marking Up and Completing the Estimates
    1. Breakdown of mark-ups
    2. Contingencies
    3. Estimate submittal
E. Other Plumbing and Heating Estimates
    1. Change order analysis
    2. Estimating additions and alterations
    3. Budget estimating
    4. Systems approach to plumbing costs

XXXIII. CUSTOMER RELATIONS AND BUSINESS PRACTICES

A. Dress and Appearance - First Impressions
   1. Clothing
      a. neat
      b. clean
   2. Personal Appearance
      a. cleanliness
      b. personal hygiene
      c. manners
         1. polite
         2. tactful

B. Courtesy to the Customer
   1. Telephone communication
      a. courteous
      b. sincere
      c. listen
      d. never argue but stand on facts
      e. misunderstanding produces ill will
   2. Association in person
      a. call customer by name
      b. pronounce name correctly
      c. efficient service
      d. brief, thorough
      e. satisfy complaints
      f. enthusiasm about company
      g. enthusiasm about product

C. Custom Psychology
   1. Get the customer's story
   2. Agreement precedes disagreement
   3. Knowledge of product
   4. Ignorance kills customer confidence
   5. Show initiative

D. Business Practices
   1. Maintain good records
      a. customer files
      b. service calls
      c. time spent
      d. parts used
      e. billings
      f. correspondence
      g. inventory
      h. service bulletins
      i. cost (all costs)
      j. taxes (all taxes)
      k. gross income
      l. net profit

E. Ethics
   1. Workmanship
   2. Parts cost
   3. Labor cost
   4. Overhead cost
   5. Promptness
   6. Contractual and implied obligations
   7. Customer consideration

STUDENT PROGRESS RECORD

A major principle of vocational education is that students learn skills or the performance of operations of a trade with the production job as a vehicle to accomplish this objective.

The operations are defined on the shop progress record and it is imperative that the instructor have some means of recording the student experiences and achievement.

The approved method of recording student progress is as follows:

INSTRUCTED - This designation on the progress record indicates that the student has performed a skill with the assistance of and under the supervision of the instructor.

PRACTICED - This designation on the progress record indicates that the student has performed a skill with little help from the instructor.

PROFICIENT - This designation on the progress record indicates that the student is capable of performing a skill within a reasonable amount of time with no assistance from the instructor. In effect, this implies that the student has been tested for that skill.

This method of noting student progress will define accurately student achievement and, in fact, will point out any weaknesses the student may have in certain operations, thus highlighting areas where the student may need help.

Grades should be kept on student daily progress cards or in roll books.

Grade _____ Year _____ Instructor _____

STUDENT	TOOL CHECK NO.	LOCKER NO.	TEXT BOOK NO.	SHOP GRADES MARKING PERIOD						THEORY GRADES MARKING PERIOD					
				1	2	3	4		F	1	2	3	4		F

40

Grade_____ Year_____ Instructor_____

TOOL CHECK NO.	LOCKER NO.	TEXT BOOK NO.	SHOP GRADES MARKING PERIOD						THEORY GRADES MARKING PERIOD					
			1	2	3	4		F	1	2	3	4		F

Grade _____ Year _____ Instructor _____

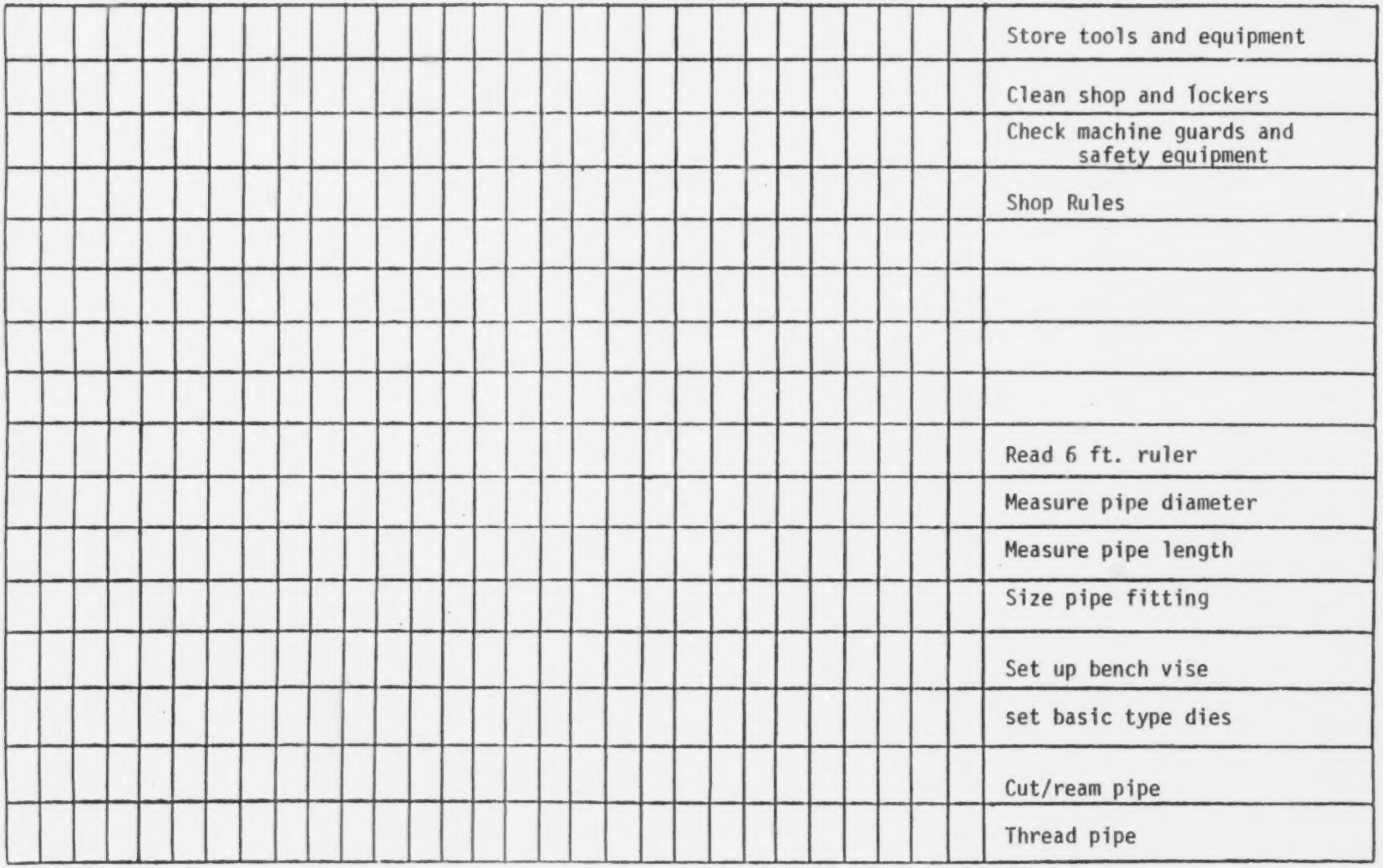
TOOL CHECK NO.	LOCKER NO.	TEXT BOOK NO.	SHOP GRADES MARKING PERIOD						THEORY GRADES MARKING PERIOD					
			1	2	3	4		F	1	2	3	4		F

Grade_____ Year_____ Instructor_____

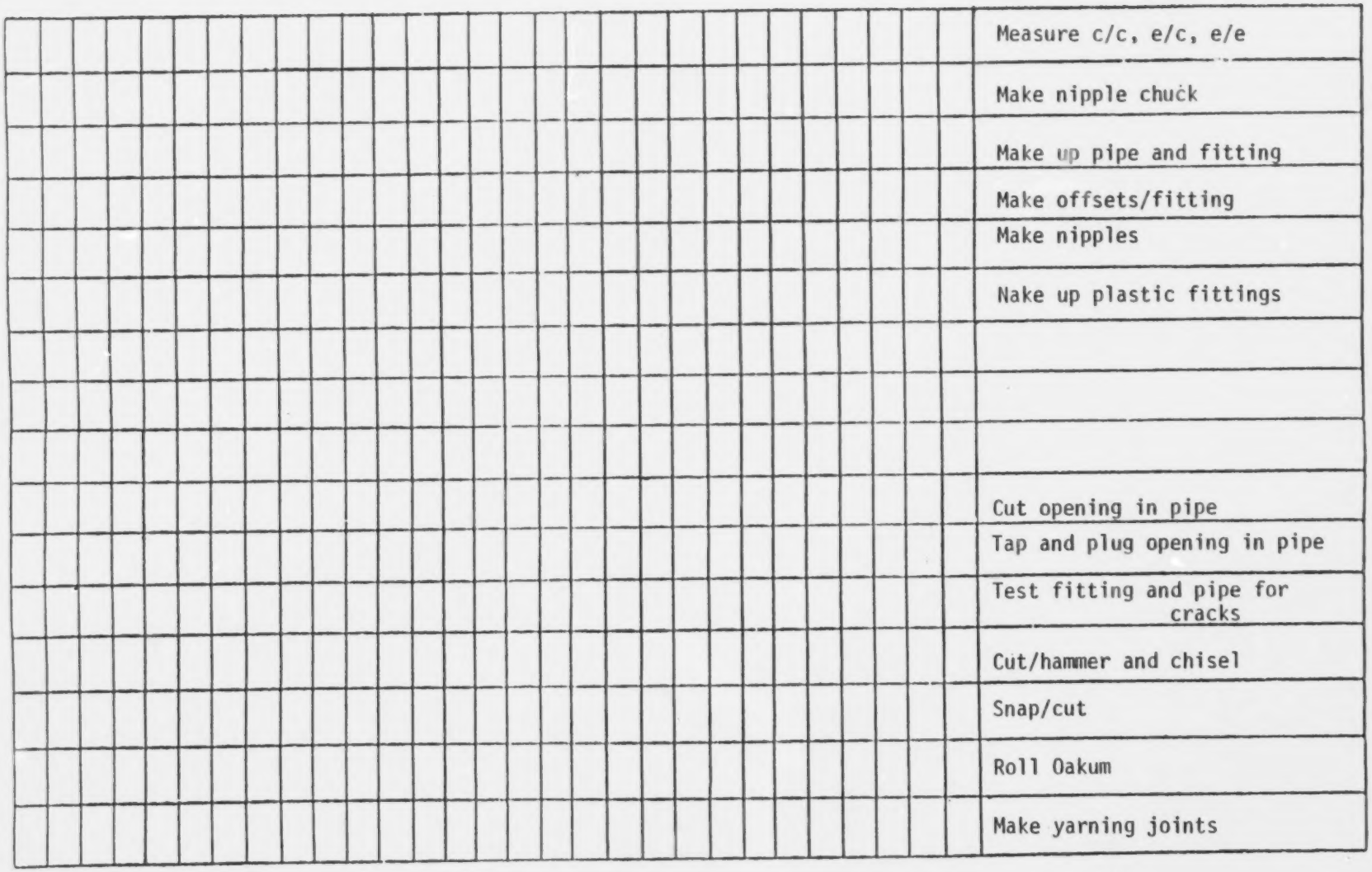
TOOL CHECK NO.	LOCKER NO.	TEXT BOOK NO.	SHOP GRADES MARKING PERIOD						THEORY GRADES MARKING PERIOD					
			1	2	3	4		F	1	2	3	4		F

Grade_____ Year_____ Instructor_____

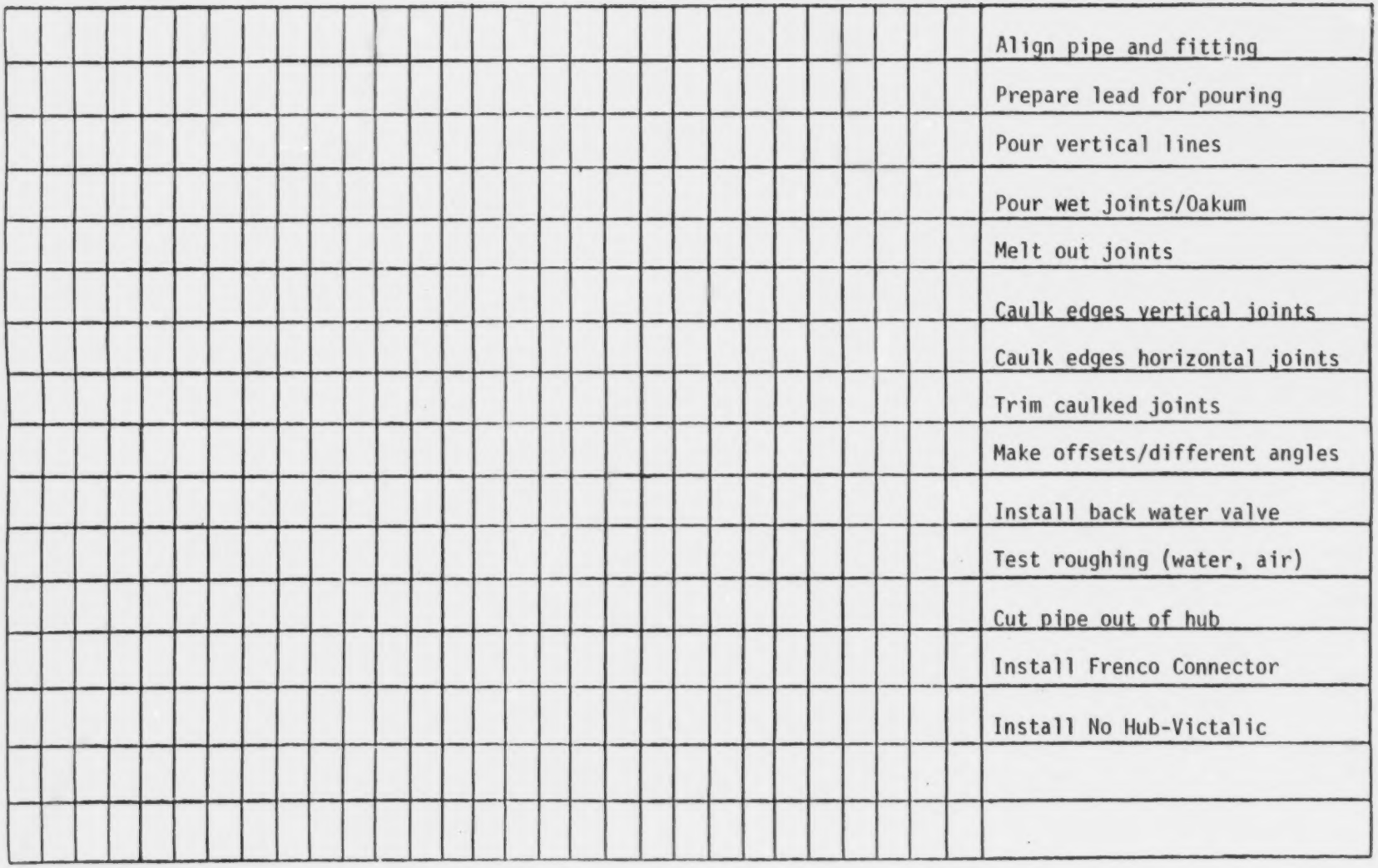
TOOL CHECK NO.	LOCKER NO.	TEXT BOOK NO.	SHOP GRADES MARKING PERIOD						THEORY GRADES MARKING PERIOD					
			1	2	3	4		F	1	2	3	4		F



	Store tools and equipment
	Clean shop and lockers
	Check machine guards and safety equipment
	Shop Rules
	Read 6 ft. ruler
	Measure pipe diameter
	Measure pipe length
	Size pipe fitting
	Set up bench vise
	set basic type dies
	Cut/ream pipe
	Thread pipe


Measure c/c, e/c, e/e
Make nipple chuck
Make up pipe and fitting
Make offsets/fitting
Make nipples
Nake up plastic fittings

Cut opening in pipe
Tap and plug opening in pipe
Test fitting and pipe for cracks
Cut/hammer and chisel
Snap/cut
Roll Oakum
Make yarning joints


Align pipe and fitting
Prepare lead for pouring
Pour vertical lines
Pour wet joints/Oakum
Melt out joints
Caulk edges vertical joints
Caulk edges horizontal joints
Trim caulked joints
Make offsets/different angles
Install back water valve
Test roughing (water, air)
Cut pipe out of hub
Install Frenco Connector
Install No Hub-Victalic

IV. SWEAT COPPER TUBING/FITTINGS

	Different types/solder
	Identify stock
	Make allowance for bends
	Cut/cutter or hacksaw
	Ream and chamfer ends
	Bend tubing
	Size for sweating
	Clean for sweating
	Select and apply flux
	Align
	Sweat/torch and electric heating
	Sweat copper stacks
	Make flared joints
	Make compression fitting

V. WATER HEATER, INSTALL AND REPAIR

VI. SET LAVATORIES AND EQUIPMENT

	Electric water heaters	Gas water heaters	Oil water heaters	Make vert. boiler connections	Make horizontal boiler connections	Install tankless heater	Install relief valves	Install and operate safety dev.	Install automatic controls	Install mixing valves		Check roughing measure	Uncrate fixtures	Install hangers/wall fixture	Install lavatory and trim	

VII. WATER HEATING, BASIC

VIII. POWER TOOLS AND EQUIPMENT

	Locate boiler and burner	Build boiler foundation	Set and level boiler base	Compute buildings heating load	Compute sizes of boilers	Size pipe, mains, returns, risers	Compute radiation needed		Operate 1/2" electric drill	Operate pipe threading machine	Operate electric hammer	Operate electric saws-all	Operate electric skill saw	Operate bench grinder	Operate drill press	Operate 1/4" electric drill

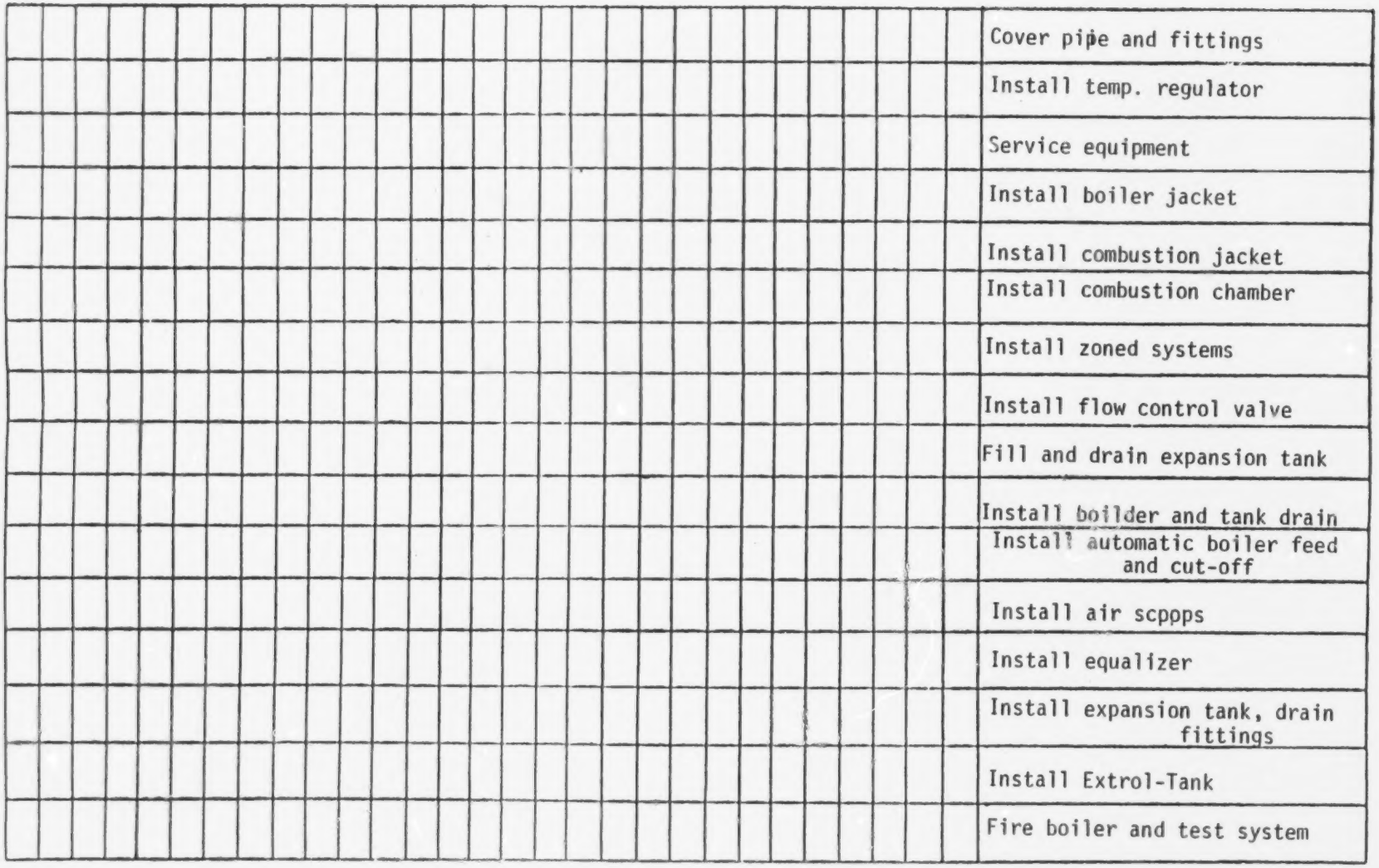
VIII. POWER TOOLS AND EQUIPMENT (CONT'D)

IX. DOMESTIC FIXTURES AND EQUIP.

Operate Sewer snake											Install kitchen sink and trim	Install wash trays	Install vacuum breaker	Install bathtub and trim	Install water closet and trim

IX. DOMESTIC FIXTURES AND EQUIP. (CONT'D)

	Install shower bath and trim	Install drinking fountain and trim	Install urinals and trim	Install flushometers	Install miscellaneous fixtures											


Cover pipe and fittings
Install temp. regulator
Service equipment
Install boiler jacket
Install combustion jacket
Install combustion chamber
Install zoned systems
Install flow control valve
Fill and drain expansion tank
Install boilder and tank drain
Install automatic boiler feed and cut-off
Install air scppps
Install equalizer
Install expansion tank, drain fittings
Install Extrol-Tank
Fire boiler and test system

XI. GLASS PIPE AND FITTINGS

	Select required tools	Cut		Bead	Install connectors	Hang glass pipe	Test glass pipe	Bury underground	Back fill trenches							

XII. CAST IRON REPAIR WORK

XIII. INSTALL BURNERS AND CONTROLS

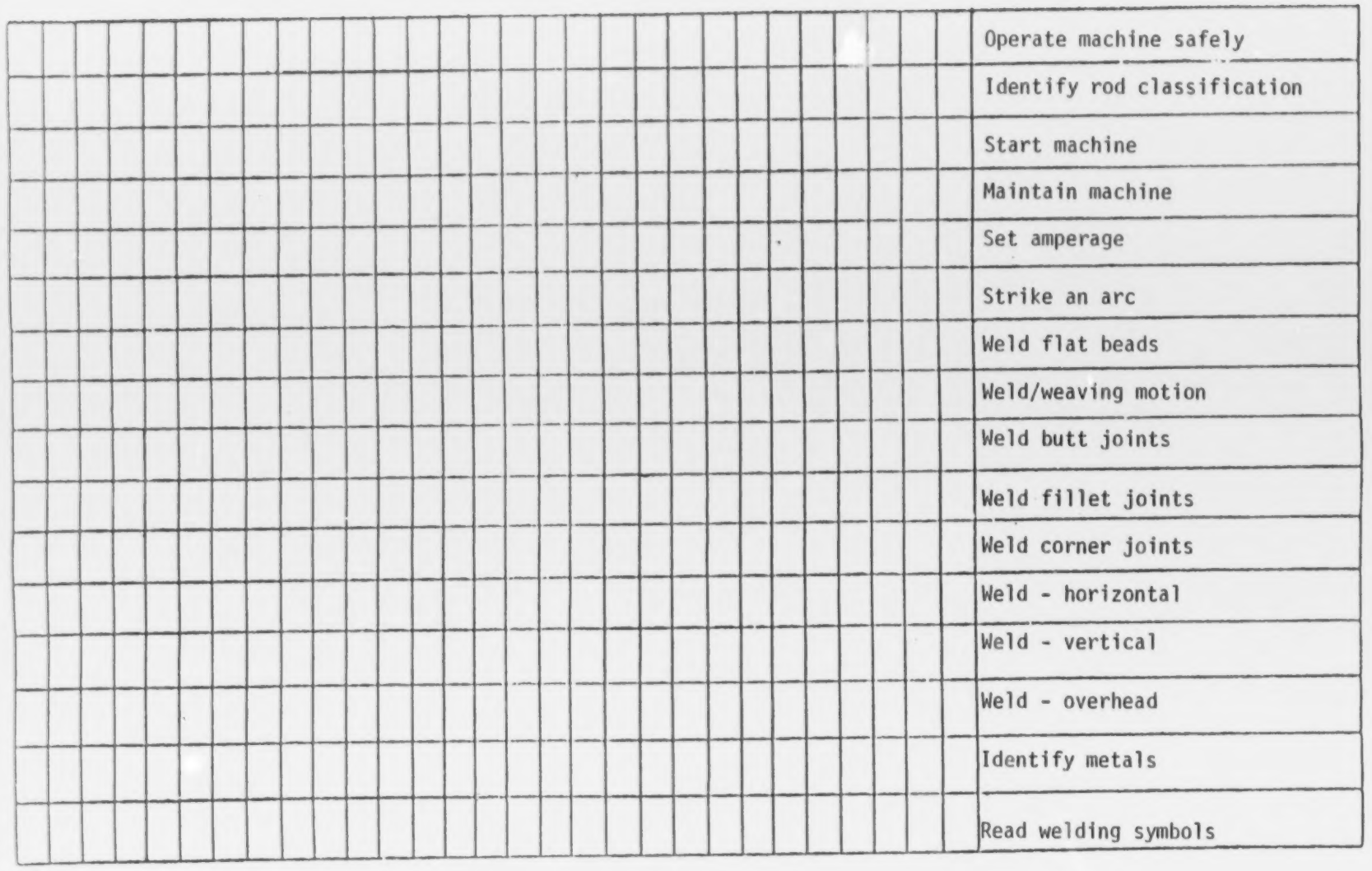
| | | |

XIV. OXYGEN-ACETYLENE WELDING

Check equipment and safety features
Check cylinders
Assemble hoses
Select tip
Set regulator
Light torch safely
Adjust flame
Weld tent position, no rod
Weld flat position
Weld butt joint
Weld lap joint
Weld T-joint
Braze flat/bronze rod
Braze pipe vertical position
Braze pipe horizontal position
Shut off torch

XIV. OXYGEN-ACETYLENE WELDING (CONT'D)

	Store equipment	Assemble cutting torch	Cut flat stock	Cut bar stock	Cut pipe stock											


Operate machine safely
Identify rod classification
Start machine
Maintain machine
Set amperage
Strike an arc
Weld flat beads
Weld/weaving motion
Weld butt joints
Weld fillet joints
Weld corner joints
Weld - horizontal
Weld - vertical
Weld - overhead
Identify metals
Read welding symbols

XVI. TEST EQUIPMENT

XVII. TROUBLE SHOOTING/Meters

	Test/OHM meter	Test/voltmeter/ammeter	Test/voltage tests	Test/V.O.M.	Test/wattmeter			Check feeders	Check fuses/record results	Check opens	Check shorts	Check grounds	Check relays, switches, controls	Check motors, transformers, coils		

| | | |

XIX. SERVICING (CONT'D)

XX. SERVICING

Cut floor timbers
Level floor pockets
Bore holes in wood
Drill steel and cast iron
Drill concrete and brick
Cut floor and walls for pipe
Repair faucet and valve
Cut gauge glass
Tend tool crib
Store materials
Level built-in bath handles
Test for gas leaks
Caulk leaks

BIBLIOGRAPHY

Slater, Harry and Lee Smith, Advanced Plumbing, Delmar Publishers, 1987

Ripka, L.V., Plumbing Installation and Design, American Technical Publishers, 1987

BOCA, BOCA National Plumbing Code Book, BOCA International

Slater, Harry and Lee Smith, Basic Plumbing, Delmar Publishers, 1987

PLUMBING APPRENTICE RELATED CURRICULUM

PREPARED BY EASTCONN
ROUTE 6 (HAMPTON)
NORTH WINDHAM, CT 06256

PREPARED FOR:

CONNECTICUT STATE DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL, TECHNICAL AND ADULT EDUCATION
VOCATIONAL-TECHNICAL SCHOOL SYSTEM
MIDDLETOWN, CONNECTICUT

PROJECT DIRECTOR
DONALD THOMPSON

PROJECT STAFF
ROBERT MARTIN, CHAIRPERSON
STEVE TYBURSKI

THIS PROJECT WAS SUPPORTED BY FUNDS MADE AVAILABLE TO CONNECTICUT
THROUGH P.L. 98-524

ALL OPINIONS EXPRESSED REFLECT THE VIEWS OF THE AUTHORS AND ARE NOT
NECESSARILY THOSE OF THE CONNECTICUT STATE DEPARTMENT OF EDUCATION

1989

26: Plumbing

Apprentice Related Curriculum

First Year

1. A0001 Trade Mathematics
2. A0031 Building Trades BPR Basic
3. A0706 Drain-Waste-Vent Systems
4. A0708 Fixture Appliances and Installation

Second Year

1. A0705 Water Supply
2. A0703 Science I
3. A0033 Building Trades BPR
4. A0709 Special Piping and Installation

Third Year

1. A0036 Plumbing BPR
2. A0704 Science II
3. A0710 Electricity and Control
4. A0729 Heating Code

Fourth Year

1. A0007 Business Math
2. A2102 Welding (36 Hours)
3. A0711 Plumbing Code Part 1
4. A0741 Plumbing Code Part 2

Note: Boca Plumbing Code Book Required for A0711 and A0741

GENERAL DESCRIPTION OF PLUMBING TRADE

Apprentice Component

The plumbing trade is a licensed trade, and in order to be employed by a contractor, an individual must hold a valid state license. A registered plumbing apprentice with a valid identification card from the Labor Department may be employed and must follow a schedule of work processes in which an apprentice receives training and experience on the job. There is a progressively increasing schedule of wages in eight steps, each 1,000 hours of completion and culminating at the journeyman rate. The period of training requires four years (8,000 hours) and is in two parts: 1) work training experience, and 2) related instruction.

Proper supervision of on-the-job training with adequate facilities to train apprentices is assured.

The apprentice's progress, both in job performance and related instruction, is evaluated periodically and appropriate records are maintained; successful completions are recognized and forwarded to the Labor Department Apprenticeship Division.

Related Component

The related training, 16 units of instruction, one unit representing 36 hours, is usually completed in 12 three-hour sessions for a total of 576 hours.

The objective of the program is to meet the requirements for achieving journeyman status and meeting the company's exact apprentice training requirements.

The related training is provided in the classrooms and shops of the Regional Vocational-Technical School System by lectures, discussions, use of models, visual aids, lab experiments, assignments, examinations and through the use of the vocational school equipment.

A0001 - TRADE MATHEMATICS

LENGTH: 36 Hours

DESCRIPTION: This course will enable students to solve problems involving angles, areas, weights, measures, rectangles, triangles, and volumes through the English and metric systems as these problems apply to the trade of their choice. It will also provide a review of basic arithmetic operations.

COMPETENCIES: The student will:

- o solve problems with an accuracy of no less than seventy percent (70%)
- o demonstrate basic mathematic operations
- o apply English and metric Systems to a variety of problems found in their trade.

I. Basic Operations - Review

A. Real numbers
   1. addition
   2. multiplication
   3. subtraction
   4. division

B. Fractions and decimal fractions
   1. addition
   2. subtraction
   3. multiplication
   4. division
   5. conversion from fractions to decimals

C. Percentages and ratios
   1. theory and percentage
   2. computation of average
   3. computation of interest rates
   4. ratio and proportion

D. Roots and squares
   1. of whole numbers
   2. of decimals
   3. of fractions
   4. use of handbook tables in terms of roots

II. Areas

A. Squares and rectangles
B. Triangles and irregular figures

III. Volumes

A. Cubes and rectangles
B. Cylinders
C. Irregular shapes

IV. Charts and Graphs

A. Types of graphs:
   1. bar
   2. linear
   3. circular
   4. interpreting graphs and charts from handbooks

V. Metric System

A. Conversion from English to metric system
   1. linear measure
   2. square measure
   3. cubic measure

TEXTBOOKS: Refresher Math. Edwin I. Stein, Allyn and Bacon, Inc., 1984.
Applied General Mathematics. Robert D. Smith, Delmar Pub. Inc., 1984.

RESOURCES: Chalkboard lectures
Problems - worksheets
Homework assignments
Tests
Trade Applications
Flash cards

A0031 - BUILDING TRADES BLUEPRINT READING

LENGTH: 36 Hours

DESCRIPTION: Provide the apprentice with the ability to interpret orthographic projections, isometric and detail drawings.

COMPETENCIES: The student will be able to:

- o apply above skills to problems associated with their trade
- o read and interpret blueprints
- o perform above skills with an accuracy of no less than 70%.

I. Reading Drawings

- A. Pictorial drawings
- B. Perspective drawings
- C. Isometric drawings
- D. Oblique drawings
- E. Three-view drawings

II. Reading Elevation Drawings

- A. Design of building
- B. The roof
- C. Openings
- D. Dimensions
- E. Exterior finish
  - 1. materials
  - 2. trim
- F. Miscellaneous details

III. Reading Floor Plans

- A. Importance
- B. Basic ideas in reading plans
- C. Reading floor plans
  - 1. one story house
  - 2. two story house
  - 3. one-and-one-half story house

IV. Symbols and Notations

- A. Materials
- B. Building parts

V. Scaling and Dimensional Practices

A. The architect's scale
B. Reading a scale
C. Measuring blueprints
D. Drawing symbols or conventions to scale
E. Dimensioning standards
   1. exterior walls
   2. interior partitions
F. Dimensioning methods
G. Windows and doors

VI. Reading Blueprints for Structural Information

A. Construction types
B. Platform framing
C. Balloon framing
D. Plank and beam framing
E. Brick veneer construction
F. Masonry buildings
G. Unit construction
H. Prefabricated houses

VII. Reading Detail Drawings

A. Dimensions
B. Locating detail
C. Details of interior wall elevations
D. Details of the structure
E. Window and door details
F. Details of trim
   1. exterior
   2. interior

VIII. Reading Blueprints for Trade Information

A. Types of trade information
B. Division of labor
C. Specifications
D. Modular and component concepts
E. Electrical work
F. Plumbing
G. Sheet metal
H. Heat and air conditioning
I. Concrete work and masonry
J. Welding

TEXTBOOKS: Building Trades Blueprint Reading, 5th Edition, Part 1 Fundamentals. E.W. Sundberg, American Technical Publishers Inc., 1987.
Basic Construction Blueprint Reading. Mark W. Huth, Delmar Publishers Inc., 1989.

RESOURCES: Chalkboard lectures
Scaling and dimensional practice
Reading actual blueprints
Testing

A0706 - DRAIN-WASTE-VENT SYSTEMS

LENGTH: 36 Hours

DESCRIPTION: This course is designed to describe and develop the basic technical information of Drain-Waste-Vent Systems, its background and its relation to public health, safety, and welfare. The student should be able to test his/her mastery with a test score of no less than seventy percent (70%).

COMPETENCIES: The student will be able to:

- o size DWV systems
- o install drainage systems
- o understand the importance of traps and pumps.

I. Piping Material

- A. Cast iron
- B. Steel
- C. Cement
- D. Clay
- E. Copper
- F. Plastic
- G. Brass
- H. Glass

II. Fittings

- A. Types
- B. Sizes and specifications
- C. Joining dissimilar piping

III. Joining Pipe and Fittings

- A. Threading
- B. Welding
- C. Soldering
- D. Brazing
- E. Compression fittings
  1. flaring pipe
  2. bending pipe
  3. assembling pipe
  4. cutting
- F. Working with piping materials

IV. Sizing DWV Systems

- A. Fixture units
- B. Flow rate
- C. Determining load
- D. Minimum sizes
- E. Offsets

V. Drainage System and Installation

A. Design factors
B. Sovent and Durham Systems
C. Direction and pitch of drainage lines
D. Sewer excavation
E. Types of drains
   1. house
   2. branch
   3. floor
F. Roughing-in
G. Building a stack
H. Testing the system
I. Waste piping
J. Rainwater drainage

VI. Vents and Venting

A. Main and branch vents
B. Pipe sizes
C. Types of vents
   1. soil vent
   2. waste vent
   3. water closets
   4. continuous vents
   5. stack vents
   6. circuit vents
   7. loop vents
   8. wet vents

VII. Traps and Interceptors

A. Trap functions
B. Trap seals
C. Trap positioning
D. Trap venting
E. Grease interceptors
F. Traps for storm drains and leaders

VIII. Ejectors and Pumps

A. Discharge below sewer level
B. Sumps
C. Sizing
D. Large building requirements
E. Sump venting

IX. Private Sewage Disposal Systems

A. Septic tanks
   1. bacterial action
   2. capacity
   3. location
   4. testing

B. Disposal field location and size
C. Distribution line patterns
D. Distribution boxes
E. Seepage pits
F. Cesspools
G. Commercial and industrial wastes

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers, 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers, 1980.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Assignments
Models
Discussions
Testing
Visual aids: filmstrips, video tapes

A0708 - FIXTURES, APPLIANCES AND INSTALLATION

LENGTH: 36 Hours

DESCRIPTION: To enable the student to install fixtures and appliances to the manufacturer's specifications and the appropriate code.

COMPETENCIES: The student will be able to:

- o properly install fixtures and appliances according to local codes
- o select the proper fixtures for installation
- o properly test for leaks.

I. Water Closet - Types and Makes

A. Check roughing-in measurements
B. Place closet bolts in floor flange
C. Set bowl in place
D. Mount closet tank
E. Connect flexible supply to fixture
F. Test fixture for leaks
G. Adjust height of water in tank

II. Lavatory - Types and Makes

A. Refer to roughing-in sheets
B. Proper heights of installation
C. Locating fixture hanger (bracket), if vanity, use Huddee Rim and how it is installed
D. Connection of trap
E. Use of flexible supply connections
F. Testing fixture and pipes for leaks

III. Bath Tubs -- Installing bathtub and trim, types and makes

A. Check roughing-in measurements
B. Size of drain and water lines
C. Installation of trap
D. Installation of tub diverter (types and different roughing-in measurements)
E. Installation of drip lever (types adjustments)
F. Testing for leaks

IV. Kitchen Sinks -- Installing kitchen sinks, types and makes

A. Install Huddee rim
B. Install trim (faucets and strains)
C. Install trap (sizes of traps)
D. Install waste arm and tee
E. Hook up of water supplies

V. Drinking Fountains -- Installing drinking fountain and trim

A. Check roughing-in sheets
B. Check local plumbing code requirements
C. Determine proper size trap for waste lines
D. Hook up of trap (types)
E. Hook up of water line (flexible or solid)

VI. Urinals -- Installing Urinal (types)

A. Types of urinals in use
B. Local plumbing code requirements for waste and vent lines
C. Why base of urinal is set in sand
D. Flushing fixtures (flush-o-meter values, flow control values)
E. Air chamber (types and use)

VII. Automatic Washing Machine -- Installing Automatic Washing Machine Hookup

A. Local plumbing code requirements
B. Check roughing-in measurement
C. Hot and cold water supplies
D. Types of valves for water (single or double valves)
E. Direct connection
F. Discharge into open stand pipe
G. Type of trap used

VIII. Garbage Disposal -- Installing Garbage Disposals

A. Check types and makes
B. Check manufacturer's roughing measurements
C. Low roughing-in type
D. Installation of an electric switch on cold water
E. Servicing disposals (what to look for if a problem comes up)

IX. Dishwashers -- Installing Dishwashing Machines

A. Check local plumbing code requirements
B. Size of waste line
C. Size of vent line
D. Installation of anti-siphon valve
E. Roughing-in measurements
F. Hook up of hot water line
G. Location of trap

X. Dental Chairs -- Installing Dental Chairs

A. Refer to local plumbing code requirements
B. Waste line
C. Vent line
D. Water supply
E. air line
F. Check for leaks
G. Type of waste connection used
H. Use of a running trap

XI. Shower Stalls -- Installing shower stalls

A. Types (steel-fiber glass)
B. Location of drain
C. Diverters (types)
D. Roughing-in of vents and drains
E. Testing fixture for leaks
F. Installation of water
G. Installation of drains

XII. Gas Appliances

A. Types of appliances
B. Types of installation
C. Local code requirements
D. Types of connections
E. Types of vents
F. Piping

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers, 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers, 1980.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Assignments
Models
Discussions
Testing
Available visual aids

A0705 - WATER SUPPLY

LENGTH: 36 Hours

DESCRIPTION: The student will know the sources of water, its distribution and treatment to supply potable water for both private and public use.

COMPETENCIES: The student will be able to:

- o understand distribution systems
- o properly size and install water services
- o properly install fixtures to prevent pollution.

I. Water Sources

A. Streams, lakes
B. Subsurface supplies

II. Private Water Distribution

A. Ground water sources
B. Types of wells
C. Tests
   1. drilling
   2. pumps
   3. duration
   4. bacterial and chemical

III. Municipal Water Distribution

A. Domestic
B. Industrial, commercial
C. Fire prevention

IV. Types of Pollution

A. Direct connection between potable and nonpotable; potable and sewerage
B. Indirect connection
C. Submerged inlet fixtures
D. Cross connections

V. Prevention of Pollution

A. Proper fixture and valve installation
B. Proper vacuum breaker and air gap installation

VI. Water Contamination

A. Cesspools
B. Leaching fields

C. Privies
D. Septic tanks
E. Stagnation
F. Surface drainage

VII. Water Treatment

A. Purification
B. Softening

VIII. Water Service Piping

A. Proper sizing and installation
B. Distribution
    1. controls
        a. single dwelling
        b. multiple dwelling
    2. water pipe sizing
        a. fixture types
        b. fixture units
    3. pressures
        a. minimum
        b. maximum
        c. auxiliary pressure
        d. hazards and noise

IX. Hot Water Distribution

A. Sizing
    1. tanks
    2. heaters
    3. piping
B. Return circulation
C. Special controls
    1. tempering valves

X. Heater Safety Requirements

A. Excessive pressures
B. Reducing valves
C. Temperature and pressure relief valves

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers, 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers, 1980.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Boca Code Book
Assignments
Discussions
Testing

A0703 - SCIENCE I

LENGTH: 36 Hours

DESCRIPTION: To enable the plumber, steamfitter and pipefitter to apply scientific principles in the daily performance of his/her job.

COMPETENCIES: The student will be able to:

- o apply science laws to his/her trade
- o understand the importance of BTUs and energy
- o understand the operation of measuring devices.

I. Measurements

- A. Symbols and abbreviations
- B. Definitions
- C. Notation and numeration
- D. Ratio and proportion
- E. Mensuration

II. Mass and Weight

III. Density

IV. Specific Gravity

- A. Definition
- B. Four methods of calculation

V. Water

VI. Heat

- A. Sensible heat
- B. Latent heat
- C. Three methods of transfer

VII. Heat and Work

- A. The British thermal unit
- B. Mechanical force and motion
- C. Standard unit of work

VIII. Joule's Experiment

IX. Energy

A. Potential energy
B. Kinetic energy
C. Conservation of energy

X. Power

A. Definition
B. Relationship to rate and time

XI. Pressure

A. The atmosphere
B. Pascal's experiment and law
C. How liquids transmit pressure

XII. Barometer

A. Mercury barometer
B. Aneroid barometer

XIII. Pressure Scales

A. Gauge - P.S.I.G.
B. Absolute - P.S.I.A.

XIV. Thermometers

A. The Fahrenheit scale
B. The Centigrade scale

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers, 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers, 1980.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Assignments
Discussions
Testing
Lab experiments in Science department

A0033 - BUILDING TRADES BLUEPRINT READING

LENGTH: 36 Hours

DESCRIPTION: This course is designed to meet the needs of the building trades and provide the student with the skills to read blueprints and estimate materials. It also provides the student with the skills to make working drawings from building plans and specifications.

COMPETENCIES: The student will be able to:

- o construct working drawings from specifications
- o recognize and identify symbols of all other building trades on construction site
- o interpret elevations, plot plans, floor plans and dimensioning.

Residential

A. General information and specifications
   1. dimensions
   2. scale
   3. elevation
   4. plan views
      a. plot
      b. basement
      c. floor
   5. schedules

B. Commercial building
   1. structure
      a. steel framework
      b. reinforce concrete slab
      c. masonry construction
      d. frame construction
      e. light steel construction

C. Estimating
   1. concrete
   2. framing
   3. masonry
   4. wet and dry walls
   5. special interior covering
   6. paints
   7. windows, doors
   8. hardware
   9. electric wiring
   10. plumbing
   11. sheet metal
   12. heating and air conditioning
   13. labor
   14. other millwork and paneling

TEXTBOOKS: Building Trades Printreading, Part 2 - Residential and Light Commercial Construction. Sundberg and Proctor, American Technical Publishers, 1987.

RESOURCES: Chalkboard lectures
Reading of residential and commercial plans
Homework assignment utilizing branch bank prints (5) included in text package
Testing

A0709 - SPECIAL PIPING AND INSTALLATION

LENGTH: 36 Hours

DESCRIPTION: This course is designed to meet the needs of the building trades and provide the student with the skills to read blueprints and estimate materials. It also provides the student with the skills to make working drawings from building plans and specifications.

COMPETENCIES: The student will be knowledgeable in:

- o special plumbing methods
- o the use of glass piping
- o the characteristics and types of plastic piping.

I. Gas Piping

- A. Installation of gas piping
- B. Location of gas meter
- C. Size of piping
- D. Piping material for LP gases
- E. Test methods

II. Fuel Tank

- A. Installation
- B. Vents, fill and overflow pipes
- C. Testing

III. Plastic Piping

- A. Characteristics and types
  1. ABS - Acrylonitrile Butadiene Styrene
  2. PVC - Polyvinyl Chloride
  3. CPVC - Chlorinated Polyvinyl Chloride
  4. PE - Polyethylene
  5. PB - Polybutylene
  6. PBS - Polybutylene Styrene
  7. PP - Polypropylene
- B. Plastic fittings

IV. Glass Piping

- A. Industrial uses
  1. dairy products
  2. food services
  3. chemicals
  4. process observation
- B. Advantages and characteristics
- C. Fiberglass pipe

V. Special Plumbing

A. Drinking water
B. Motels
C. Emergency facilities
   1. hospitals
   2. dental offices
   3. nursing homes
D. Dry cleaning establishments

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers, 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers, 1980.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Models
Assignments
Discussions
Testing

A0036 - BLUEPRINT READING FOR PLUMBERS

LENGTH: 36 Hours (Class and Lab)

DESCRIPTION: This course is designed to develop the ability to interpret trade blueprints and to plan the installation of the required plumbing. The student should be able to make orthographic or isometric sketches for plumbing installations. He/she will perform these skills to an accuracy of no less than seventy percent (70%).

COMPETENCIES: The student will be able to:

- o estimate the material needs of a given installation
- o draw an isometric drawing of the job layout
- o interpret blueprints and specifications

I. Pipe Drawings

A. Introduction to pipe drawing
B. Scale (Architects)
C. Floor Plan

II. Isometric Pipe Layout

A. Fundamentals of isometric drawing
B. Drawing isometric pipe drawings

III. Interpreting Residential Blueprints

A. Visualizing the building
B. Sewage disposal systems
C. Drains
D. Stack and vent piping
E. Water piping
F. Gas piping
G. Roughing
H. Specifications
I. Code

IV. Commercial Building

A. Plot plans
B. Elevations and plumbing installation
C. Drains
D. Vents
E. Specifications
F. Plumbing installation
G. Gas installation
H. Code

TEXTBOOKS: Blueprint Reading for Plumbers - Residential and Commercial.
Arcangelo and Guest, Delmar Publishing, 1985.

RESOURCES: Chalkboard lectures
Assignments
Testing
Apple or IBM computer and estimating software

AO704 - SCIENCE II

LENGTH: 36 Hours

DESCRIPTION: To enable the plumber, steamfitter and pipe fitter to apply scientific principles in the daily performance of his/her job.

COMPETENCIES: The student will be able to:

- understand radiation characteristics of different metals
- understand the operation of various pumps
- understand expansion and contraction of matter.

I. Steam

A. Saturated
B. Superheated
C. Gaseous steam or stem gas
D. Wet

II. Mechanical Powers and the Principles of Work

A. The lever
B. The wheel and axle
C. The pulley
D. The inclined plane
E. The screw
F. The wedge

III. Expansion and Contraction

A. Solids
B. Liquids
C. Gases

IV. Melting Point of Solids

A. Fusion
B. Vaporization
C. Evaporation

V. Gravity

A. Falling bodies
B. Center of gravity
C. Momentum
D. Friction

VI. Flowing Water in Pipes

A. Hydrostatics
B. Hydrodynamics

VII. Elementary Pumps

A. Lift pumps and force pumps
B. Reciprocating pumps, centrifugal pumps, turbine pumps, ejector pumps, and rotary gear pumps

VIII. Materials for Systems and their Properties

A. Cast iron
B. Malleable iron
C. Wrought iron
D. Steel
E. Copper
F. Brass
G. Aluminum
H. Sheet metals

IX. Pipe and Tubing

A. Properties
B. Grades
C. Use application
D. Methods of joining

X. Tools

A. Hand tools
B. Threading tools and machines
   1. internal
   2. external

XI. Soldering

A. Methods - soft, hard, brazing, welding gas and electric

XII. Energy Sources

A. Locally
B. Projected

XIII. Safety - OSHA to date

XIV. Pipe Fitting

A. Measurements
B. Pipe cutting
C. Pipe tapping
D. Pipe threading
E. Pipe bending
F. Assembling

87

XV. Gas Piping

A. A.G.A. Standards

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers, 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers, 1980.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Assignments
Discussions
Testing
Lab experiments in Science department

A0710 - ELECTRICITY AND CONTROLS

LENGTH: 35 Hours

DESCRIPTION: This course is intended to provide the piping trade apprentice with fundamental electric concepts essential to understand the function and application of the equipment he/she serves.

COMPETENCIES: The student will be able to:

- o understand the principles of DC and AC currents
- o understand the operation of electric controls
- o understand the operation of pneumatic controls.

I. Fundamentals of Electricity

- A. Electron theory
- B. Static electricity
- C. Producing electricity
- D. Magnetism

II. Fundamentals of Electric Circuits

- A. Terms
- B. Electromagnetism
- C. Fuses and protective devices
  1. types and sizes, where, when, why to use
- D. Series and parallel circuits
  1. practical application
  2. recognition and effects of each
- E. Electrical conductors and wiring
  1. diagrams
  2. symbols
- F. Capacitors
- G. Generator principles
- H. Transformer

III. Electric Construction Materials and Tools

- A. Demonstration and practice

IV. National Electric Code

- A. Purpose; basis minimum safety provision;
  Contents - several chapters;
  Authority - widely used as law in addition to having local codes to supplement it;
  Discussion of how the NBC and local codes affect electrical installation procedure.

V. Controls - Principles

A. Electric temperature control
   1. basic principle of operation
   2. demonstration
B. Pneumatic temperature control
   1. basic principle of operation
   2. demonstration

TEXTBOOKS: Technician's Manual, Petroleum Marketing Education Foundation, 1989.

RESOURCES: Chalkboard lectures
Assignments
Discussions
Testing
Lab experiments in HVAC shop

A0729 - HEATING CODE

LENGTH: 36 Hours

DESCRIPTION: The apprentice will be able to interpret and clarify the regulations of the Boca National Mechanical Code needed for the plumbing and heating trades.

COMPETENCIES: The student will be able to:

- o interpret the Boca National Mechanical Code
- o pass the heating code test with no less than 70%
- o quickly find the regulations pertaining to specific jobs.

I. Article 1 - Administration and Enforcement

A. M-100 to M-123

II. Article 2 - Definitions

A. M-200 to M-201

III. Article 3 - Air Distribution Systems

A. M-300 to M-311

IV. Article 4 - Mechanical Equipment

A. M-400 to M-408

V. Article 5 - Kitchen Exhaust System

A. M-500 to M-508

VI. Article 6 - Boilers and Water Heaters

A. M-600 to M-608

VII. Article 7 - Hydronic Piping

A. M-700 to M-709

VIII. Article 8 - Gas Piping Systems

A. M-800 to M-813

IX. Article 9 - Fuel Oil Piping

A. M-900 to M-906

X. Article 10 - Combustion Air

A. M-1000 to M-1005

XI. Article 11 - Clearance Reduction

A. M-1100 to M-1101

XII. Article 12 - Chimneys and Vents

A. M-1200 to M-1217

XIII. Article 13 - Mechanical Refrigeration

A. M-1300 to M-1306

XIV. Article 14 - Solid Fuel Burning Appliances

A. M-1400 to M-1404

XV. Article 15 - Incinerators and Crematories

A. M-1500 to M-1503

XVI. Article 16 - Ventilation Air

A. M-1500 to M-1605

XVII. Article 17 - Air Quality

A. M-1700 to M-1704

XVIII. Article 18 - Solar Heating and Air Cooling System

A. M-1800 to M-1803

XIX. Article 19 - Energy Conservation

A. M-1900 to M-1903

XX. Article 20 - Boilers and Pressure Vessels

A. M-2000 to M-2002 - Maintenance and inspection

TEXTBOOKS: Boca National Mechanical Code - Latest Edition. Boca International, 1987.

RESOURCES: Chalkboard lectures
Assignments
Discussions
Referral to Boca Code Sections and Articles
Testing

A0007 - BUSINESS MATHEMATICS

LENGTH: 36 Hours

DESCRIPTION: This course will provide the student with the skills required to operate a business and will include bookkeeping, ordering of material, inventory procedures, insurance, payrolls and discounting.

The student will be able to organize procedures to conduct a one-person operation of a small business.

COMPETENCIES: The student will be able to:

- o calculate payrolls, overhead costs
- o conduct a small business
- o gain an appreciation of his/her employer's obligations

Bookkeeping

A. Necessity of bookkeeping
   1. entries
      a. credits
      b. debits
      c. cash records

B. Payroll
   1. hourly and weekly salaries
   2. insurance (Workmans' Compensation)
   3. FICA
   4. health insurance
   5. other fringe benefits

C. Computation of cost of service or product
   1. time
   2. material
   3. overhead costs (includes nonproductive help, heat, light, local taxes, etc.)
   4. equipment amortization

D. Inventory
   1. amortization
   2. insurance purposes
      a. fire
      b. theft
   3. tax purposes

TEXTBOOKS: Consumer Mathematics. Lange, Mason, Rousos, Houghton Mifflin Co., 1989.

RESOURCES: Chalkboard lectures
Assignments - worksheets
Testing

A2102 - WELDING

LENGTH: 36 Hours

DESCRIPTION: This course will enable the apprentice to gain skills and to apply them to his/her occupation.

COMPETENCIES: The student will be able to:

- o draw a weld bead
- o join metals by fusion
- o cut metal by flame.

I. Safety Instruction

A. Safety practices
B. Care and use of equipment

II. Arc Welding

A. Machines and accessories
B. Metal electrodes and characteristics
C. Definitions and terms

III. Identification of Common Metals

A. Characteristics
B. Methods of identification
C. Alloys

IV. Joints and Welds

A. Types of joints
B. Types of welds
C. Strengths of joints
D. Simple testing

V. Flat and Vertical Welding

VI. Brazing

VII. Flame Cutting

TEXTBOOKS: Welding: Principles and Applications. Jeffus and Johnson, Delmar Publishing Inc., 1988.

RESOURCES: Chalkboard lectures
Demonstrations
Photos
Hands-on welding in shop
Testing

A0711 - PLUMBING CODE - PART 1

LENGTH: 36 Hours

DESCRIPTION: The apprentice will be able to interpret and clarify the regulations of the Boca National, state and local plumbing codes. The student will be prepared to take the state plumbing examination.

COMPETENCIES: The student will be able to:

- o interpret and clarify the Boca National Plumbing Code
- o pass the code test with at least 70% accuracy
- o quickly identify pertinent articles for his/her work

I. Article 1 - Administration and Enforcement

- A. General
- B. Permits
- C. Violations

II. Article 2 - Definitions

- A. General
- B. Plumbing terms

III. Article 3 - General Regulations

- A. Health and safety
- B. Plumbing connections
- C. Piping characteristics and considerations
  1. P-305.0 to P-312.0

IV. Article 4 - Materials

- A. General
- B. Standards
- C. Types of materials
  1. piping systems
  2. special
  3. fixture

V. Article 5 - Joints and Connections

- A. General
- B. Between similar materials
- C. Between dissimilar materials

VI. Article 6 - Sanitary Drainage Systems

- A. General
- B. Sizing and installation

VII. Article 7 - Indirect and Special Waste Piping

A. General
B. Indirect wastes
C. Special wastes

VIII. Article 8 - Storm Drainage Systems

A. General
B. Violations
C. Sizing and building storm sewers and leaders
D. Types of drains
E. Conductors and connections
F. Controlled flow roof drain systems
G. Subdrains
H. Traps on drains and leaders

TEXTBOOKS: Boca National Plumbing Code - Latest edition. Boca International, 1987.

RESOURCES: Chalkboard lectures
Referral to code book
Assignments
Testing
Discussions

A0741 - PLUMBING CODE - PART 2

LENGTH: 36 Hours

DESCRIPTION: The apprentice will be able to interpret and clarify the regulations of the Boca National, state and local plumbing codes. The student will be prepared to take the state plumbing examination.

COMPETENCIES: The student will be able to:

- o interpret the Boca National Plumbing Code
- o pass the state code exam with not less than 70%
- o quickly identify required information.

I. Article 9 - Vents and Venting

- A. General
- B. Sizing
- C. Vent stacks
- D. Types of venting
- E. Frost closure

II. Article 10 - Traps, Interceptors, Separators and Backwater Valves

- A. General
- B. Fixture traps
- C. Interceptors and separators
- D. Backwater valves

III. Article 11 - Drainage Pipe Cleanouts

- A. General
- B. Underground drainage
- C. Concealed piping
- D. Flow direction
- E. Cleanouts
  1. size
  2. clearances
  3. access
- F. Manholes

IV. Article 12 - Plumbing Fixtures

- A. General
- B. Minimum plumbing facilities
- C. Handicap facilities
- D. Fixtures
  1. installation
  2. water closets
  3. urinals
  4. flushing devices

5. bidets
6. lavatories
7. bathtubs
8. showers
9. sinks
10. food grinders
11. dishwashers
12. clothes washers
13. floor drains

E. Special fixtures
1. drinking fountains
2. faucets and sittings
3. emergency stations

V. Article 13 - Hangers and Supports

A. General
B. Attachment methods

VI. Article 14 - Health Care Plumbing

A. General
B. Water supply
C. Drainage and venting
D. Special fixtures

VII. Article 15 - Water Supply and Distribution

A. General
B. Water service and requirements
C. Design of water system
D. Installing water system
E. Potable water
1. protection
2. disinfection
F. Hot water supply system

VIII. Article 16 - Individual Water Supply

A. General
B. Water supply
1. types
2. quantity and quality
3. protection of supply
C. Pumping equipment

IX. Article 17 - Inspection, Tests and Maintenance

A. General
B. Inspections
C. Testing of systems
D. Maintenance

X. Article 18 - Engineered Plumbing Systems

A. General
B. Plans and specifications
C. Engineering inspections
D. Design criteria
E. Drainage and vent systems

TEXTBOOK: Boca National Plumbing Code - Latest Edition. Boca International, 1987.

RESOURCES: Chalkboard lectures
Referral to code book
Assignments
Testing
Discussions

HEATING AND COOLING APPRENTICE RELATED CURRICULUM

PREPARED BY EASTCONN
ROUTE 6 (HAMPTON)
NORTH WINDHAM, CT 06256

PREPARED FOR:

CONNECTICUT STATE DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL, TECHNICAL AND ADULT EDUCATION
VOCATIONAL-TECHNICAL SCHOOL SYSTEM
MIDDLETOWN, CONNECTICUT

PROJECT DIRECTOR
DONALD THOMPSON

PROJECT STAFF
ROBERT MARTIN, CHAIRPERSON
STEVE TYBURSKI

THIS PROJECT WAS SUPPORTED BY FUNDS MADE AVAILABLE TO CONNECTICUT
THROUGH P.L. 98-524

ALL OPINIONS EXPRESSED REFLECT THE VIEWS OF THE AUTHORS AND ARE NOT
NECESSARILY THOSE OF THE CONNECTICUT STATE DEPARTMENT OF EDUCATION

1989

30: Heating and Cooling

Apprentice Related Curriculum

First Year

1. A0001 Trade Mathematics
2. A0031 Building Trades BPR Basic
3. A0703 Science I
4. A0704 Science II

Second Year

1. A0717 Heating I
2. A0033 Building Trades BPR
3. A0718 Heating II
4. A0036 BPR for Plumbers

Third Year

1. A0710 Electricity and Controls
2. A0719 Basic Refrigeration
3. A0720 Domestic Refrigeration
4. A0712 Oil Burner and Furnace

Fourth Year

1. A0709 Special Piping
2. A0721 Commercial Refrigeration
3. A0722 Air Conditioning
4. A0729 Heating Code

Fifth Year (Electives)

1. A0714 Oil Burner Units and Auxiliaries
2. A2101, A2102 Welding (Gas and Electric)
3. A0715 Oil Burner Controls
4. A0711 and A0741 Plumbing Code Review Part 1 and 2 (Optional)

Note: Boca Plumbing Code Book Required for A0711 and A0741

GENERAL DESCRIPTION OF HEATING AND COOLING TRADE

Apprentice Component

The heating and cooling trade is a licensed trade, and in order to be employed by a contractor, an individual must hold a valid state license. A registered heating and cooling apprentice with a valid identification card from the Labor Department may be employed and must follow a schedule of work processes in which an apprentice is to receive training and experience on the job. There is a progressively increasing schedule of wages in eight steps, one every 1,000 hours of completion culminating at the journeyman rate. The period of training requires four years (8,000 hours) and is in two parts: 1) work training experience, and 2) related instruction.

Proper supervision of on-the-job training with adequate facilities to train apprentices is assured.

The apprentice's progress, both in job performance and related instruction, is evaluated periodically and appropriate records are maintained; successful completions are recognized and forwarded to the Labor Department Apprenticeship Division.

Related Component

The related training, 16 units of instruction, one unit representing 36 hours, is usually completed in 12 three-hour sessions for a total of 576 hours.

The objective of the program is to meet the requirements for achieving journeyman status and meeting the company's exact apprentice training requirements.

The related training is provided in the classrooms and shops of our Vocational Schools by lectures, discussions, use of models, visual aids, lab experiments, assignments, examinations and through the use of the Vocational School equipment in our shop departments. The apprentice and related program is to be completed in a four-year period.

A0001 - TRADE MATHEMATICS

LENGTH: 36 Hours

DESCRIPTION: This course will enable students to solve problems involving angles, areas, weights, measures, rectangles, triangles, and volumes through the English and metric systems as these problems apply to the trade of their choice. It will also provide a review of basic arithmetic operations.

COMPETENCIES: The student will:

- o solve problems with an accuracy of no less than seventy percent (70%)
- o demonstrate basic mathematic operations
- o apply English and metric systems to a variety of problems found in their trade.

I. Basic Operations - Review

A. Real numbers
   1. addition
   2. multiplication
   3. subtraction
   4. division

B. Fractions and decimal fractions
   1. addition
   2. subtraction
   3. multiplication
   4. division
   5. conversion from fractions to decimals

C. Percentages and ratios
   1. theory and percentage
   2. computation of average
   3. computation of interest rates
   4. ratio and proportion

D. Roots and squares
   1. of whole numbers
   2. of decimals
   3. of fractions
   4. use of handbook tables in terms of roots

II. Areas

A. Squares and rectangles
B. Triangles and irregular figures

III. Volumes

A. Cubes and rectangles
B. Cylinders
C. Irregular shapes

IV. Charts and Graphs

A. Types of graphs:
   1. bar
   2. linear
   3. circular
   4. interpreting graphs and charts from handbooks

V. Metric System

A. Conversion from English to metric system
   1. linear measure
   2. square measure
   3. cubic measure

TEXTBOOKS: Refresher Math. Edwin I. Stein, Allyn and Bacon, Inc., 1984.
Applied General Mathematics. Robert D. Smith, Delmar Pub. Inc., 1984.

RESOURCES: Chalkboard lectures
Problems - worksheets
Homework assignments
Tests
Trade Applications
Flash cards

RESOURCES:

A0031 - BUILDING TRADES BLUEPRINT READING

LENGTH: 36 Hours

DESCRIPTION: Provide the apprentice with the ability to interpret orthographic projections, isometric and detail drawings.

COMPETENCIES: The student will be able to:

- o apply above skills to problems associated to their trade
- o read and interpret blueprints
- o perform above skills with an accuracy of no less than 70%.

I. Reading Drawings

A. Pictorial drawings
B. Perspective drawings
C. Isometric drawings
D. Oblique drawings
E. Three-view drawings

II. Reading Elevation Drawings

A. Design of building
B. The roof
C. Openings
D. Dimensions
E. Exterior finish
    1. materials
    2. trim
F. Miscellaneous details

III. Reading Floor Plans

A. Importance
B. Basic ideas in reading plans
C. Reading floor plans
    1. one-story house
    2. two-story house
    3. one-and-one-half-story house

IV. Symbols and Notations

A. Materials
B. Building parts

V. Scaling and Dimensional Practices

A. The architect's scale
B. Reading a scale
C. Measuring blueprints
D. Drawing symbols or conventions to scale
E. Dimensioning standards
   1. exterior walls
   2. interior partitions
F. Dimensioning methods
G. Windows and doors

VI. Reading Blueprints for Structural Information

A. Construction types
B. Platform framing
C. Balloon framing
D. Plank and beam framing
E. Brick veneer construction
F. Masonry buildings
G. Unit construction
H. Prefabricated houses

VII. Reading Detail Drawings

A. Dimensions
B. Locating detail
C. Details of interior wall elevations
D. Details of the structure
E. Window and door details
F. Details of trim
   1. exterior
   2. interior

VIII. Reading Blueprints for Trade Information

A. Types of trade information
B. Division of labor
C. Specifications
D. Modular and component concepts
E. Electrical work
F. Plumbing
G. Sheet metal
H. Heat and air conditioning
I. Concrete work and masonry
J. Welding

TEXTBOOKS: Building Trades Blueprint Reading, 5th Edition, Part 1 Fundamentals. E.W. Sundberg, American Technical Publishers Inc., 1987.
Basic Construction Blueprint Reading. Mark W. Huth, Delmar Publishers Inc., 1989.

RESOURCES: Chalkboard lectures
Scaling and dimensional practice
Reading actual blueprints
Testing

A0703 - SCIENCE I

LENGTH: 36 Hours

DESCRIPTION: To enable the plumber, steamfitter and pipefitter to apply scientific principles in the daily performance of his/her job.

COMPETENCIES: The student will be able to:

- o apply science laws to his trade
- o understand the importance of BTUs and energy
- o understand the operation of measuring devices.

I. Measurements

- A. Symbols and abbreviations
- B. Definitions
- C. Notation and numeration
- D. Ratio and proportion
- E. Mensuration

II. Mass and Weight

- A. General properties

III. Density

- A. Relationship to water

IV. Specific Gravity

- A. Definition
- B. Four methods of calculation

V. Water

- A. Characteristics as related to temperature

VI. Heat

- A. Sensible heat
- B. Latent heat
- C. Three methods of transfer

VII. Heat and Work

- A. The British thermal unit
- B. Mechanical force and motion
- C. Standard unit of work

VIII. Joule's Experiment

IX. Energy

A. Potential energy
B. Kinetic energy
C. Conservation of energy

X. Power

A. Definition
B. Relationship to rate and time

XI. Pressure

A. The atmosphere
B. Pascal's experiment and law
C. How liquids transmit pressure

XII. Barometer

A. Mercury barometer
B. Aneroid barometer

XIII. Pressure Scales

A. Gauge - P.S.I.G.
B. Absolute - P.S.I.A.

XIV. Thermometers

A. The Fahrenheit scale
B. The Centigrade scale

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers, 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers. 1980.
Starbuck's Plumbing Series, Vols. 1-4, Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Discussions
Assignments
Testing
Lab experiments in Science Department

A0704 - SCIENCE II

LENGTH: 36 Hours

DESCRIPTION: To enable the plumber, steamfitter and pipe fitter to apply scientific principles in the daily performance of his/her job.

COMPETENCIES: The student will be able to:

- o understand radiation characteristics of different metals
- o understand the operation of various pumps
- o understand expansion and contraction of matter.

I. Steam

A. Saturated
B. Superheated
C. Gaseous steam or stem gas
D. Wet

II. Mechanical Powers and the Principles of Work

A. The lever
B. The wheel and axle
C. The pulley
D. The inclined plane
E. The screw
F. The wedge

III. Expansion and Contraction

A. Solids
B. Liquids
C. Gases

IV. Melting Point of Solids

A. Fusion
B. Vaporization
C. Evaporation

V. Gravity

A. Falling bodies
B. Center of gravity
C. Momentum
D. Friction

VI. Flowing Water in Pipes

A. Hydrostatics
B. Hydrodynamics

VII. Elementary Pumps

A. Lift pumps and force pumps
B. Reciprocating pumps, centrifugal pumps, turbine pumps, ejector pumps, and rotary gear pumps

VIII. Materials for Systems and their Properties

A. Cast iron
B. Malleable iron
C. Wrought iron
D. Steel
E. Copper
F. Brass
G. Aluminum
H. Sheet metals

IX. Pipe and Tubing

A. Properties
B. Grades
C. Use application
D. Methods of joining

X. Tools

A. Hand tools
B. Threading tools and machines
   1. internal
   2. external

XI. Soldering

A. Methods - soft, hard, brazing, welding gas and electric

XII. Energy Sources

A. Locally
B. Projected

XIII. Safety - OSHA to date

XIV. Pipe Fitting

A. Measurements
B. Pipe cutting
C. Pipe tapping
D. Pipe threading
E. Pipe bending
F. Assembling

XV. Gas Piping

A. A.G.A. Standards

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers, 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers, 1980.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Discussions
Assignments
Testing
Lab experiments in Science Department

A0717 - HEATING I

LENGTH: 36 Hours

DESCRIPTION: This course will provide the apprentice with information which he/she can apply to the installation, troubleshooting and maintenance of residential steam and hot water heating systems.

COMPETENCIES: The student will be able to:

- o understand the principles of steam heating
- o install steam and hot water heating systems
- o understand and install radiation piping systems.

I. Introduction

A. A history of steam and hot water heating, old and new

II. The One-Pipe Gravity Steam System

A. Operation and installation lay-out
B. Minimum installation requirements
C. Boiler connections
D. The Hartford loop
E. Advantages and disadvantages

III. The Two-Pipe Gravity Steam System

A. Piping arrangements and the advantages over the one-pipe system
B. Advantages and disadvantages

IV. The Vapor Steam Systems

A. Typical boiler and radiation piping arrangements
B. Advantages and disadvantages

V. Return Trap System

A. Typical piping systems and specialties
B. Advantages and disadvantages

VI. Condensate Return Systems

A. Typical piping systems and specialties
B. Advantages and disadvantages

TEXTBOOKS: Boca National Mechanical Code - Latest Edition. Boca International, 1987.
Starbucks's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Assignments
Discussions
Referral to code book
Testing

A0033 - BUILDING TRADES BLUEPRINT READING

LENGTH: 36 Hours

DESCRIPTION: This course is designed to meet the needs of the Building Trades and provide the student with the skills to read blueprints and estimate materials. It also provides the student with the skills to make working drawings from building plans and specifications.

COMPETENCIES: The student will be able to:

- o construct working drawings from specifications
- o recognize and identify symbols of all other building trades involved on construction site
- o interpret elevations, plot plans, floor plans and dimensioning.

Residential

A. General information and specifications
   1. dimensions
   2. scale
   3. elevation
   4. plan views
      a. plot
      b. basement
      c. floor
   5. schedules

B. Commercial building
   1. structure
      a. steel framework
      b. reinforce concrete slab
      c. masonry construction
      d. frame construction
      e. light steel construction

C. Estimating
   1. concrete
   2. framing
   3. masonry
   4. wet and dry walls
   5. special interior covering
   6. paints
   7. windows, doors
   8. hardware
   9. electric wiring
   10. plumbing
   11. sheet metal
   12. heating and air conditioning
   13. labor
   14. other millwork and paneling

TEXTBOOKS: Building Trades Printreading, Part 2 - Residential and Light Commercial Construction. Sundberg and Proctor, American Technical Publishers, 1987.

RESOURCES: Chalkboard lectures
Reading of residential and commercial plans
Homework assignment utilizing branch bank prints (5) included in text package
Testing

A0718 - HEATING II

LENGTH: 36 Hours

DESCRIPTION: This course will provide the apprentice with information which he/she can apply to the installation, troubleshooting and maintenance of residential steam and hot water heating systems.

COMPETENCIES: The student will be able to:

- o install hot water systems
- o plan a heating system
- o troubleshoot a hot water heating system.

I. Gravity Hot Water Heating Systems

- A. Operation and installation lay-out
- B. Minimum installation requirements
- C. Boiler connections
- D. Advantages and disadvantages
- E. Upfeed direct return system
- F. Upfeed reverse return system
- G. Downfeed systems
- H. Open expansion tank system
- I. Pressure or closed system

II. Forced Hot Water Systems

- A. A series loop system
- B. A one-pipe system
- C. A two-pipe system

III. Radiant Panel Heating

- A. Typical piping arrangements for floor, wall and ceiling panels
- B. Typical piping arrangements for snow melting panels

IV. Planning a Heating System

- A. A comprehensive training in the use of I.B.R. Manuals H-21, No. 200, No. 250

V. Fuel Oil Tank Installation

- A. Full sector covering the installation of fuel oil tanks as required under the State of Connecticut Basic Building requirements, National Board of Fire Underwriters requirements, and the State Fire Marshall's regulations.
- B. Advantages and disadvantages

VI. Vacuum Systems

A. Typical piping systems and specialties
B. Advantages and disadvantages

VII. Steam Heating Accessories

A. Valves and check valves
B. The air vent and the vacuum valve
C. Pop safety valve
D. Strainers
E. Steam separators and oil separators
F. Flush tanks

VIII. Water Feeders and Cutoffs

A. Types and their safety duties
B. Piping arrangements

IX. Water Level Controllers and the Piping Arrangements

A. Operation and maintenance

X. Steam Traps

A. Types and piping arrangements

XI. Boilers and Heat Transfer Units

A. Heating unit connections
B. Types of boilers
C. Construction

TEXTBOOKS: Boca National Mechanical Code - Latest Edition, Boca International, 1987.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Assignments
Discussions
Referral to code book
Testing

A0036 - BLUEPRINT READING FOR PLUMBERS

LENGTH: 36 Hours (Class and Lab)

DESCRIPTION: This course is designed to develop the ability to interpret trade blueprints and to plan the installation of the required plumbing. The student should be able to make orthographic or isometric sketches for plumbing installations. He/she will perform these skills to an accuracy of no less than seventy percent (70%).

COMPETENCIES: The student will be able to:

- o estimate the materials needed of a given installation
- o draw an isometric drawing of the job layout
- o interpret blueprints and specifications.

I. Pipe Drawings

A. Introduction to pipe drawing
B. Scale (Architects)
C. Floor Plan

II. Isometric Pipe Layout

A. Fundamentals of isometric drawing
B. Drawing isometric pipe drawings

III. Interpreting Residential Blueprints

A. Visualizing the building
B. Sewage disposal systems
C. Drains
D. Stack and vent piping
E. Water piping
F. Gas piping
G. Roughing
H. Specifications
I. Code

IV. Commercial Building

A. Plot plans
B. Elevations and plumbing installation
C. Drains
D. Vents
E. Specifications
F. Plumbing installation
G. Gas installation
H. Code

TEXTBOOK: Blueprint Reading for Plumbers - Residential and Commercial.
Arcangelo and Guest, Delmar Publishing Co., 1985.

RESOURCES: Chalkboard lectures
Assignments
Testing
Apple or IBM Computer and estimating software

A0710 - ELECTRICITY AND CONTROLS

LENGTH: 36 Hours

DESCRIPTION: This course is intended to provide the piping trade apprentice with fundamental electric concepts essential to understand the function and application of the equipment he/she serves.

COMPETENCIES: The student will be able to:

- o understand the principles of DC and AC currents
- o understand the operation of electric controls
- o understand the operation of pneumatic controls.

I. Fundamentals of Electricity

- A. Electron theory
- B. Static electricity
- C. Producing electricity
- D. Magnetism

II. Fundamentals of Electric Circuits

- A. Terms
- B. Electromagnetism
- C. Fuses and protective devices
  1. types and sizes, where, when, why to use
- D. Series and parallel circuits
  1. practical application
  2. recognition and effects of each
- E. Electrical conductors and wiring
  1. diagrams
  2. symbols
- F. Capacitors
- G. Generator principles
- H. Transformer

III. Electric Construction Materials and Tools

- A. Demonstration and practice

IV. National Electric Code

- A. Purpose; basis minimum safety provision;
  Contents - several chapters;
  Authority - widely used as law in addition to having local codes to supplement it;
  Discussion of how the NBC and local codes effect electrical installation procedure.

V. Controls - Principles

A. Electric temperature control
   1. basic principle of operation
   2. demonstration
B. Pneumatic temperature control
   1. basic principle of operation
   2. demonstration

TEXTBOOKS: Technician's Manual. Petroleum Marketing Education Foundation, 1989.

RESOURCES: Chalkboard lectures
Assignments
Discussions
Testing
Lab experiments in HVAC shop

A0719 - BASIC REFRIGERATION

LENGTH: 36 Hours

DESCRIPTION: This course is intended to provide the student with the applied theory of thermodynamics and the refrigeration cycle.

COMPETENCIES: The student will be able to:

- o understand the operation of the refrigeration cycle
- o understand the types of refrigerants and their uses
- o read and interpret measuring devices.

I. History

- A. Ice age
- B. Ancient and medieval
- C. Cold cellar, ice box

II. Principles of Refrigeration

- A. Matter
- B. Atom
- C. Molecular - elements - compounds
- D. Symbols
- E. Refrigerants
- F. Evaporation condensation

III. Temperature - Pressure - Measurement

- A. Thermometers - pyrometers
- B. Fahrenheit scale
- C. Centigrade scale
- D. Absolute scales
- E. B.T.U.
- F. Calorie
- G. Sensible heat
- H. Latent heat
- I. Conversion
- J. Pressure - Vacuum

IV. Gas Laws - Terms

- A. Dalton's
- B. Boyle's
- C. Charle's

V. Refrigeration Cycle

A. Evaporators - Cond - Metering Devices Comp.
B. Disassembling
C. Assembling
D. Systems
E. Valves
F. Charging
G. Leak detector

VI. Refrigerants and Oils

VII. Driers - Filters - Sight Glasses - Strainers

VIII. Fastening Devices

IX. Electrical

A. Circuits
B. Fuses
C. Relays
D. Testing

TEXTBOOKS: Modern Refrigeration and Air Conditioning. Althouse, Turnquist, Bracciano, Goodheart Wilcox Co. Inc., 1988.

RESOURCES: Lab experiments
Chalkboard lectures
Models
Filmstrips
Assignments
Testing

A0720 - DOMESTIC REFRIGERATION

LENGTH: 36 Hours

DESCRIPTION: This course teaches the student the construction, operating principles and usual system of domestic refrigeration.

COMPETENCIES: The student will be able to:

- o know the types and construction of cabinets for freezers and refrigerators
- o understand the complete electrical system
- o know the operation of defrosting devices.

I. Introduction

A. Purpose
B. Content

II. Types of Cabinets

A. Sizes
B. Styles
C. Combination

III. Cabinet Construction, Refrigeration and Freezer

A. Outer shell and types
B. Inner-shelving
C. Insulation
D. Gaskets
E. Hardware, closure

IV. Refrigerating Systems

A. Hermatic
B. Open type

V. Compression Systems

A. Frost
B. Divided
C. Defrost
D. No frost

VI. Compressors

A. Rotary
B. Reciprocating

VII. Condensers

A. Static
B. Forced air

VIII. Refrigerant Controls

A. Metering devices
B. Timers
C. Cold controls
D. Fan switches

IX. Evaporators

A. Static
B. Forced air

X. Electrical Circuits

A. Schematics
B. Pictorial

XI. Motors

A. S.P.C.
B. Capacitor start
C. Capacitor run

XII. Motor Controls

A. Relays
B. Thermostats

XIII. Fans

A. Evaporators
B. Condenser
C. Blade
D. Centrifugal

XIV. Defrosting Devices

A. Timers
B. Temperature
C. Pressure
D. Electrical defrost
E. Hot gas defrost system

XV. Absorption Systems

XVI. Gas Controls

TEXTBOOKS: Modern Refrigeration and Air Conditioning. Althouse, Turnquist, Bracciano, Goodheart and Wilcox Co. Inc., 1988.

RESOURCES: Lab experiments - HVAC shop
Chalkboard lectures
Assignments
Testing
Filmstrips

A0712 - OIL BURNER FUELS

LENGTH: 36 Hours

DESCRIPTION: This course will provide the student with a knowledge of their application to domestic burners. The student will also be able to assemble and disassemble domestic oil burners, select correct nozzles as they relate to combustion chambers and flame efficiency. He/she will also be able to select the maintain fuel tanks. Content will be a combination of lecture and laboratory.

COMPETENCIES: The student will be able to:

- o disassemble and reassemble oil burners
- o understand the science of fuel oils
- o use properly the test instruments used in oil heat.

I. Introduction

II. Fuel Oils

- A. Distillate fuel oil
- B. Crude oil
- C. Hydrocarbons
- D. Simple distillation
  - 1. kerosene
  - 2. premium diesel #2
  - 3. fuel oils #1 through 6
- E. Finishing operations
- F. Testing
- G. Application of distillate fuel
- H. Flash point
- I. Pour point
- J. Water and sediment
- K. Distillation temperature
- L. Viscosity
- M. Gravity
- N. Sulphur content
- O. Color

III. Combustion Testing Instruments

- A. Draft gauge
- B. CO tester
- C. Stack thermometer
- D. Smoke tester
- E. Efficiency chart

IV. Fuel Units, Tanks, High Pressure Burners

A. Types of fuel units
B. Fuel unit installation
C. Replacement units
D. Servicing fuel units
E. Testing fuel units
F. Troubleshooting

V. Nozzles

A. Spray pattern
   1. hollow
   2. solid
   3. special
B. Selection of proper nozzle
C. Oil pressure effect on nozzles
D. Effect of viscosity on nozzle performance
E. Care of nozzles
F. Test

VI. Combustion Chambers

A. Introduction
B. Chamber materials
   1. common fire brick
   2. metal fire chambers
   3. insulating fire brick
   4. ceramic chambers
   5. molded chambers
   6. miscellaneous materials
C. Chamber shapes
   1. sizing warm air furnace
   2. forced warm air steel furnaces
   3. boiler rating
D. Installing the chamber (residential)
E. Large or commercial chambers
F. Testing

TEXTBOOKS: Technician's Manual. Petroleum Marketing Education Foundation, 1987.

RESOURCES: HVAC lab experiments
CHalkboard lectures
Assignments
Testing
Available visual aids

A0709 - SPECIAL PIPING AND INSTALLATION

LENGTH: 36 Hours

DESCRIPTION: This course is designed to meet the needs of the Building Trades and provide the student with the skills to read Blueprints and estimate materials. It also provides the student with the skills to make working drawings from building plans and specifications.

COMPETENCIES: The student will knowledgeable in:

- o special plumbing methods
- o the use of glass piping
- o the characteristics and types of plastic piping.

I. Gas Piping

- A. Installation of gas piping
- B. Location of gas meter
- C. Size of piping
- D. Piping material for LP gases
- E. Test methods

II. Fuel Tank

- A. Installation
- B. Vents, fill and overflow pipes
- C. Testing

III. Plastic Piping

- A. Characteristics and types
  1. ABS - Acrylonitrile Butadiene Styrene
  2. PVC - Polyvinyl Chloride
  3. CPVC - Chlorinated Polyvinyl Chloride
  4. PE - Polyethylene
  5. PB - Polybutylene
  6. PBS - Polybutylene Styrene
  7. PP - Polypropylene
- B. Plastic fittings

IV. Glass Piping

- A. Industrial uses
  1. dairy products
  2. food services
  3. chemicals
  4. process observation
- B. Advantages and characteristics
- C. Fiberglass pipe

V. Special Plumbing

A. Drinking water
B. Motels
C. Emergency facilities
   1. hospitals
   2. dental offices
   3. nursing homes
D. Dry cleaning establishments

TEXTBOOKS: Basic Plumbing. Slater and Smith, Delmar Publishers Inc., 1980.
Advanced Plumbing. Slater and Smith, Delmar Publishers Inc., 1980.
Starbuck's Plumbing Series, Vols. 1-4. Starbuck Publishing Inc., 1984.

RESOURCES: Chalkboard lectures
Models
Discussions
Assignments
Testing

A0721 - COMMERCIAL REFRIGERATION I

LENGTH: 36 Hours

DESCRIPTION: This course will enable the student to apply the knowledge of mechanical and electrical controls for the purpose of diagnosing refrigeration problems and installing new refrigeration equipment.

COMPETENCIES: The student will be able to:

- o install refrigeration equipment
- o understand the commercial refrigeration systems
- o troubleshoot commercial refrigerators.

I. Introduction

- A. History
- B. Applications
  1. stores
  2. business
  3. trucking
  4. railroads
  5. industry

II. Commercial Systems

- A. Air cooled
- B. Water cooled
- C. Combination
- D. Open type
- E. Semi-hermatic

III. Commercial Applications

- A. High temperature
- B. Medium temperature
- C. Low temperature
- D. Ultra low temperature

IV. Compressors

- A. Single cylinder
- B. Multi-cylinder
- C. Reciprocating
- D. Rotary
- E. Heat loads
  1. system design

V. Motors and Electrical Systems

A. Systems
B. Schematics
C. Split phase
D. Capacitor
E. R.I.
F. Three-phase
G. Condenser and evaporator
    1. single-phase motors
    2. three-phase
    3. blade fans
    4. centrifugal fans

VI. Condensers and Receivers

A. Tank type
B. Shell and tube
C. Shell and coil

VII. Water and Solenoid Valves

A. Diaphragm
B. Slide
C. Gas
D. Liquid

VIII. Refrigerant Controls

A. TXV
B. AXV
C. Float controls

IX. Evaporators

A. Direct expansion
B. Flooded systems
C. Air cooling evaporators
    1. gravity
    2. frosted
    3. defrosting
    4. forced air
D. Liquid cooling evaporators
    1. immersion
    2. brine
    3. sweet water
    4. pressure

X. Suction Lines, Liquid Lines, Manifolds

A. Sizes
B. Installation
C. Design

XI. Constant Pressure Valves

A. Evaporator
B. Hot gas
C. Head pressure control

XII. Defrost Systems

A. Hot gas
B. Brine
C. Electric

XIII. Design and Application

A. System capacities
B. Selections
C. Uses

TEXTBOOKS: Modern Refrigeration and Air Conditioning. Althouse, Turnquist, Bracciano, Goodheart Wilcox Co. Inc., 1987.

RESOURCES: Field trip to local insurance building to see refrigeration equipment
Chalkboard lectures
Assignments
Testing

A0722 - AIR CONDITIONING

LENGTH: 36 Hours

DESCRIPTION: This course will enable the apprentice to apply the theory to the repair and installation of domestic and commercial air conditioning units.

COMPETENCIES: The student will be able to:

- o install domestic and commercial air conditioners
- o calculate heat losses and heat gain
- o understand and install heat pumps.

I. Introduction to Air Conditioning

A. Body comfort needs
   1. temperature control
   2. humidity control
   3. air filtering
   4. air circulation

II. Air Cycle

III. Review: The Refrigeration Cycle

IV. Psychrometrics and the Psychrometric Terms

A. Application of terms
B. Use of basic chart
C. Type of psychrometric charts
D. Psychrometric processes

V. Sources of Heat

A. Cooling and Heating Load Estimating Guides

VI. Air Distribution

A. Ducts
   1. supply systems
   2. return systems
B. Outlets

VII. Duct Sizing

A. Air volume for heating
B. Air volume for cooling

VIII. Residential Air Conditioning

A. Load estimating
   1. for heating (losses)
   2. for cooling (heat gain)

IX. Commercial Air Conditioning

A. Load estimating

X. Air Conditioning Equipment

A. Heat pump
   1. principle parts
   2. heating cycle
   3. cooling cycle
B. Installation of equipment
   1. residential
   2. small commercial

XI. Self-Contained Water Cooled Units

XII. Absorption Systems

XIII. Cooling Tower Installation

XIV. Air Conditioning Controls

A. Types of control systems
   1. electric
   2. pneumatic
   3. electronic
   4. fluidic

XV. Balancing the Air Conditioning System

A. Package systems

TEXTBOOKS: Modern Refrigeration and Air Conditioning. Althouse, Turnquist, Bracciano, Goodheart Wilcox Co. Inc., 1988.

RESOURCES: HVAC lab experiments in shop
Filmstrips
Assignments
Dismantle units
Testing

A0729 - HEATING CODE

LENGTH: 36 Hours

DESCRIPTION: The apprentice will be able to interpret and clarify the regulations of the Boca National Mechanical Code needed for the plumbing and heating trades.

COMPETENCIES: The student will be able to:

- o interpret the Boca National Mechanical Code
- o pass the heating code test with no less than 70%
- o quickly find the regulations pertaining to specific jobs.

I. Article 1 - Administration and Enforcement

A. M-100 to M-123

II. Article 2 - Definitions

A. M-200 to M-201

III. Article 3 - Air Distribution Systems

A. M-300 to M-311

IV. Article 4 - Mechanical Equipment

A. M-400 to M-408

V. Article 5 - Kitchen Exhaust System

A. M-500 to M-508

VI. Article 6 - Boilers and Water Heaters

A. M-600 to M-608

VII. Article 7 - Hydronic Piping

A. M-700 to M-709

VIII. Article 8 - Gas Piping Systems

A. M-800 to M-813

IX. Article 9 - Fuel Oil Piping

A. M-900 to M-906

X. Article 10 - Combustion Air

A. M-1000 to M-1005

XI. Article 11 - Clearance Reduction

A. M-1100 to M-1101

XII. Article 12 - Chimneys and Vents

A. M-1200 to M-1217

XIII. Article 13 - Mechanical Refrigeration

A. M-1300 to M-1306

XIV. Article 14 - Solid Fuel Burning Appliances

A. M-1400 to M-1404

XV. Article 15 - Incinerators and Crematories

A. M-1500 to M-1503

XVI. Article 16 - Ventilation Air

A. M-1500 to M-1605

XVII. Article 17 - Air Quality

A. M-1700 to M-1704

XVIII. Article 18 - Solar Heating and Air Cooling System

A. M-1800 to M-1803

XIX. Article 19 - Energy Conservation

A. M-1900 to M-1903

XX. Article 20 - Boilers and Pressure Vessels

A. M-2000 to M-2002 - Maintenance and inspection

TEXTBOOKS: Boca National Mechanical Code - Latest Edition, Boca International, 1987.

RESOURCES: Chalkboard lectures
Assignments
Discussions
Referral to Boca Code Sections and Articles
Testing

A2101 - GAS WELDING

LENGTH: 36 Hours

DESCRIPTION: This course will enable the apprentice to oxy-acetylene weld, braze and cut applying processes as they relate to his/her occupation.

COMPETENCIES: The student will be able to:

- o draw a weld beed
- o join metals by fusion
- o cut metal by flame.

I. Oxy-Acetylene Welding

A. Fusion
1. created by heat from flame
a. types of flames

II. Brazing

A. Diffusion and alloying of filler material
1. filler - lower melting point than B/M
a. types of flames

III. Equipment

A. Regulators
1. types
B. Gases
C. Torches
1. types
D. Hoses
E. Fluxes
1. purpose
F. Filler
1. welding
2. brazing
G. Associated

IV. Base Materials

A. Welding
1. type B/M
a. flame adjustment
b. filler rod
c. flux
B. Brazing
1. type B/M
a. flame adjustment
b. filler rod
c. flux

V. Fundamentals

A. Tip size
    1. pressure
        a. flames
B. Tip and flame distance
C. Torch angles
D. Rate of travel
    1. filler wire deposit
E. Flux

VI. Safety

A. Personal
B. Equipment
C. Area

VII. Fundamental Operations

A. Torch and tip size
    1. pressure
B. Adjusting flames
    1. types of flames
C. Tip to work distance
    1. flame to work distance
D. Torch angles
E. Rate of travel
    1. filler wire addition

VIII. Weld Beads Flat Plate

A. Create puddle
B. No filler

IX. Weld Beads Flat Plate

A. With filler

X. Deposit Overlay Beads on Flat Plate

XI. Weld Square Butt

A. Thin plate
B. Flat position

XII. Brazing

A. Deposit braze on plate
    1. heating technique
    2. deposit braze metal
    3. correct flow and fluxing
    4. deposit braze
    5. braze typical production joint

XIII. Burning

A. Safety
B. Fundamentals
    1. equipment
        a. torch-tips
            1. types
        b. gases - gages
    2. operations
        a. gas-pressures
        b. ignitions
        c. flame adjustment tip size
        d. pre-heat
        e. speeds
        f. piercing
C. Applications
    1. straight cuts
    2. circle
    3. bevel
    4. piercing
    5. gouging

TEXTBOOKS: Basic Oxyacetylene Welding, 4th Edition. Griffin, Roden, Briggs, Delmar Publishing Inc., 1984.

RESOURCES: Lab experiments in welding shop
Chalkboard lectures
Assignments
Testing

A2102 - ELECTRIC ARC WELDING

LENGTH: 36 Hours

DESCRIPTION: This course will enable the apprentice to gain skills and to apply them to his/her occupation.

COMPETENCIES: The student will be able to:

- o perform horizontal and vertical welding
- o understand the theory of arc welding
- o troubleshoot welding equipment.

I. Safety Instruction

- A. Safety practices
- B. Care and use of equipment

II. Theory of Arc Welding

- A. Arc welding machines and accessories
- B. Metal electrodes and characteristics
- C. Standard definitions and terms

III. Identification of Common Metals

- A. Characteristics
- B. Methods of identification
- C. Alloys

IV. Joints and Welds

- A. Types of joints
- B. Types of welds
- C. Strength of joints
- D. Simple testing

V. Flat and Vertical Position Welding

TEXTBOOKS: Welding: Principles and Applications. Jeffus and Johnson, Delmar Publishing Inc., 1988.

RESOURCES: Lab experiments in welding shop
Chalkboard lectures
Assignments
Testing
Photos